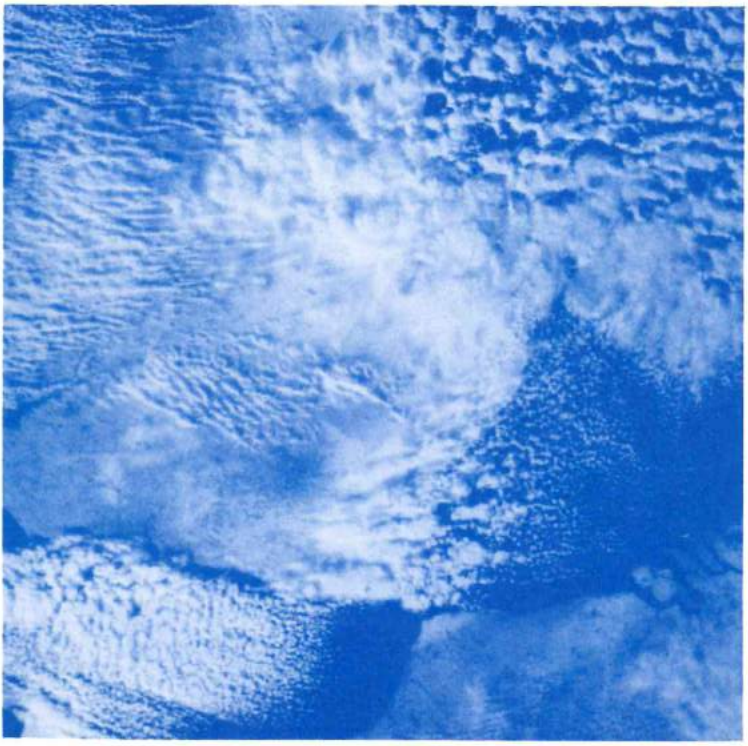
The JOURNAL of METEOROLOGY



NOAA9 SATELLITE PHOTOGRAPH AT 1404 GMT 12th JANUARY 1987: A DEEP COLD POOL (498 DM) IS CENTRED FROM EASTERN ENGLAND TO HOLLAND

Volume 12, number 118 **April 1987**

THE JOURNAL OF METEOROLOGY
LE JOURNAL DE MÉTÉOROLOGIE

Published in association with
The Tornado and Storm Research Organisation
a privately-supported research body, serving the national public interest

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Subscriptions for 1987, Volume 12, *including surface post,* U.K. £29.00; rest of world £32.00; *including airmail* £38.00. For personal subscriptions from individuals deduct £13.00 from each of these rates. Students and senior citizens £12.00 upon request.

Back issues are available for purchase either as complete volumes or singly. Volumes 1-6, £4.00 each; volumes 7-9, £8.00; volume 10, £10.00; volume 11, £12.00. Single issues, *pro rata.* These prices include postage and packing.

Published by The Artetech Publishing Co., 54 Frome Road, Bradford-on-Avon, Wiltshire, BA15 1LD.

Printed by The Dowland Press Ltd., Frome, Somerset.

ISSN 0307-5966

JOURNAL OF METEOROLOGY

"An international journal for everyone interested in climate and weather, and in their influence on man."

Editor: Dr. G. T. Meaden

Vol. 12, no. 118, April 1987

THE MID-JANUARY 1987 COLD WAVE REACHES SPAIN

By D. G. TOUT
Department of Geography, University of Manchester

Abstract: The mid-January cold wave which affected northern and western Europe also reached Spain where traffic was badly disrupted and many mountain communities cut off, especially in Asturias and Cantabria. At Madrid the windchill equivalent temperature was –18°C in the early morning of 14th January. Eleven people died as a result of the cold wave. Even lower temperatures were recorded in February 1983.

INTRODUCTION

Much of the interior of mainland Spain is no stranger to low air temperatures during the winter months because the mean altitude of the Meseta, the plateau which covers two thirds of the country, is 650m. Avila's mean January temperature, for example, is 2.4°C. At times, however, appreciably colder air reaches the Iberian Peninsula, initiating a cold wave or *ola de frío.*

In spite of the protective barrier of the Pyrenees and the Cantabrian Mountains, the coldest weather experienced in Spain arrives as a north-easterly current of continental polar air between an anticyclone over Scandinavia and a depression in the western Mediterranean. If the cold air reaches the southern and eastern coastal regions, the damage to frost-sensitive horticultural crops and citrus plantations may run into millions of pounds. The only area in peninsular Spain where the absolute minimum temperature is above 0°C is a narrow coastal strip in the south-eastern province of Almería. Although the Balearic Islands may also experience sub-zero temperatures, lowland areas of the Canary Islands, at a latitude of about 28°N, are immune on account of their position off the coast of north-west Africa. Stations at similar latitudes in Florida do record temperatures below freezing due to the long land-track of continental arctic air southwards over North America.

THE SYNOPTIC SITUATION

The cold wave which affected the whole of northern and western Europe in mid-January 1987 crossed the Pyrenees and the Cantabrian Mountains into Spain on 11th January as north-easterly winds between an intense anticyclone (1050mb) over Scandinavia and a deep depression (980mb) in the western Mediterranean introduced bitterly cold continental polar air from the U.S.S.R. The cold front heralded a spell of severe weather for northern Spain, with low temperatures, snowstorms and strong winds.

The stage had been set for the cold wave on 8th January as a secondary low developed north of the Azores and moved rapidly eastwards to cross central Spain and be over the Balearic Islands at 1200 GMT on 10th January. Meanwhile a cold

front started to move south-westwards from Scandinavia on 8th January and had reached the eastern coast of Ireland and northern France by 1800 GMT on 10th January. On 12th January snow fell in Madrid and Barcelona and by the following day 30 mountain communities in León and 50 in Cantabria had been cut off by snow as a cold front moved south-eastwards across the country.

THE COLD WAVE INTENSIFIES

The 1000-500mb thickness chart for 1200 GMT on 12th January showed a cold pool centred over eastern England and the Low Countries. This area of very cold air moved westwards to be over south-west England by 1200 GMT on the following day with a temperature of –38°C at 5500m over Ireland. The cold pool then moved southwards, to be over the Bay of Biscay by 1200 GMT on 14th January, extending its influence over the whole of the peninsula and the Balearic Islands. The temperature at 5500m over northern Spain dropped to –32°C.

At 0600 GMT on this eventful day the temperature at Madrid (Ciudad Universitaria) was –4.8°C with a 6.9m/sec wind, giving a windchill equivalent temperature of –18°C. At Puerto de Navacerrada, at an altitude of 1860m in the Sierra de Guadarrama north-west of Madrid, the air temperature fell to –15°C. Eighteen mountain passes were closed to traffic in the north of the country and the River Duero froze over in the town of Soria in Old Castile. It snowed in Palma de Mallorca and snow also fell in the town of La Coruña on the north-west coast, for the first time since February 1963. Very strong north-westerly winds in the circulation of a deep depression (982mb) situated in the Gulf of Lyon were recorded on the east coast and in the Balearic Islands. The cold forced the authorities to leave three Madrid Metro stations open on the following night as a refuge for homeless people.

Early on 15th January traffic disruption reached a peak with ten airports and 51 mountain passes closed and train schedules badly affected. 100,000 people living in mountain communities in the northern half of Spain remained isolated by the snowfalls.

As the Gulf of Lyon storm weakened and moved towards central Italy and the cold pool moved into France and the western Mediterranean temperatures started to recover but, even by the late evening of 17th January, 43 mountain passes were still closed and 80 mountain communities cut off in Cantabria.

SUMMARY

The south did not totally escape the bad weather because very strong winds, associated with the depression of 9th January as it crossed central areas of Spain, damaged about 85 per cent of the young strawberry plants in the province of Huelva, the second largest area of strawberry cultivation in the world after California. Losses are estimated at about £5,000,000.

It has been reported that the cold wave was responsible for the deaths of eleven people. The Asturias and Cantabria were the regions worst affected by traffic disruption and the isolation of mountain communities. Amongst the lowest temperatures recorded were –19°C at Puerto de Navacerrada, –11°C at Granada (710m), –10°C at León (911mb) and –7°C at Vitoria (550m).

Although intense while it lasted, even lower figures were recorded in the cold wave of 7th-17th February 1983 when the temperature fell to –20°C at Albacete

(699mb) in New Castile. This 1983 cold wave was, however, the most severe since that of 22nd December 1970 to 3rd January 1971 when –28°C was recorded in the province of Teruel.

HERIOT-WATT UNIVERSITY AUTOMATIC WEATHER STATION ON CAIRNGORM SUMMIT

The highest weather station in Britain celebrated its tenth birthday on Thursday, 12th March, 1987. At the summit of Cairngorm, Heriot-Watt University Automatic Weather Station continues day and night to provide information which may have helped to save lives over the past ten years.

In a drive to improve mountain weather forecasts following several deaths from exposure on the Cairngorm range in the early 1970's, the Department of Physics at Heriot-Watt University, Edinburgh, designed and built a weather station suitable for automatic operation in the very severe climate on the summit of Cairngorm. After prototype trials, the present station was installed on 12th March 1977. At 1245 metres above sea level, it is the highest weather station in Britain. To combat the effects of snow, heavy icing and storm-force winds, the instruments are housed inside a heated insulated shelter from which they rise every half an hour to take a three-minute reading of wind-speed, wind direction and air temperature. The readings are sent by radio to the Meteorological Office in Aviemore for

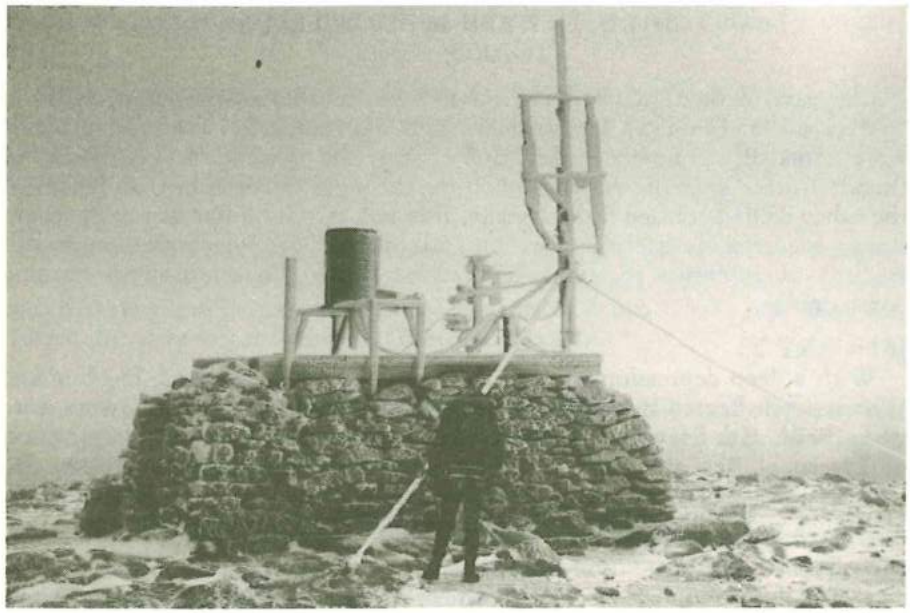

Fig.1: The Automatic Weather Station on the summit of Cairngorm. At 1245 metres (4084 feet) above sea level it is the highest weather station in Britain.

distribution on its own network, to the Chairlift Company for public display at the ski area day lodge, and to Heriot-Watt University in Edinburgh. The whole process is automatic and continues day and night.

Besides building up a long-term picture of the summit climate, the information is used daily by Glasgow Weather Centre for incorporation into the Mountainline weather forecast. More recently, the readings have been transmitted as part of a Ceefax information page giving skiing and weather conditions for Cairngorm. Over the past decade the station has opened and closed over 146,000 times and has recorded some particularly impressive wind speeds. The highest gust of 171 miles per hour occurred on 20th March 1986, while the windiest month with an average of 55 m.p.h. overall was January 1983. The highest and lowest temperatures are + 21.6 and −16.5 degrees Celsius.

The station continues to be maintained by Heriot-Watt University's Department of Physics, with assistance from the Cairngorm Chairlift Company and a contribution to running costs from the Meteorological Office. The project's director, Dr. James S. Barton, commented. "The Cairngorm Weather Station has earned its keep over the past ten years, but it continues to need financial support. Its present equipment is now becoming obsolescent and we are trying to up-grade the system with modern computer control."

DAMAGING HAIL IN GREAT BRITAIN AND IRELAND: 1985

By J. D. C. WEBB and D. M. ELSOM
TORRO, Oxford

Large and/or damaging hail is known to have occurred in Britain and Ireland on 25 days in 1985 (Table 1). The total may seem high but, as in 1984, most incidents were isolated, a notable exception being the exceptional outbreak of thunderstorms and hail over Ireland during the night of 25th-26th July. Many of the other hailfalls caused little damage, although two local but unusually severe storms occurred in eastern England on 26th May and 5th July; both these storms reached an intensity of about H5 causing much distress to local farming communities.

JANUARY 23

With a deep depression situated to the north-east of Scotland, England and Wales were affected by a rather cold north-westerly airstream. Showers were widespread, with a few reports of thunder near western coasts. The warm waters of Liverpool Bay are often a source of convective activity in winter, and thunderstorms with heavy hail occurred on Merseyside. At Heswall the largest hailstones were fully 13mm in diameter and up to 18mm in length.

MARCH 14

A cold showery north-westerly airstream became established over the British Isles, and many showers turned to hail or snow. Hail over 10mm diameter was reported from Cheltenham in Gloucestershire.

MARCH 15

A complex area of low pressure lay over Scandinavia, while a small depression, over northern Scotland at 0600, drifted southwards to be near the Humber by 2400. A broad upper trough covered western Europe. Heavy showers, again often of hail or snow, were widespread over Britain, and some became thundery. Much of the reported 'hail' was of the snow-pellet variety, but at Newcastle-under-Lyme (Staffs) hailstones up to 18mm diameter were observed. Large hail was also reported from the Coventry area. Further north at Lancaster 10mm diameter hail caused some damage to gardens. Hailstones bigger than 10mm were also reported from Stornoway (Western Isles) and County Fermanagh (Northern Ireland).

MARCH 24

A complex depression was slow-moving over Scotland with an unstable westerly airstream over southern Britain. Pea-sized hail fell in several places in southern England where thunderstorms were quite widespread. At Hinckley near Leicester a storm produced hailstones 13mm across. Cheltenham also had hail over 10mm in diameter.

MARCH 30

In an unstable south-westerly airstream south of a northward-moving occlusion, thunder was quite widespread over Ireland. Murlough (Co. Down) reported hail diameters above 10mm.

APRIL 6

A showery trough swung north-eastwards across England during the day. Some heavy thunderstorms, many with hail, moved over southern England during the afternoon. Hail exceeding 10mm diameter fell at Boscombe Down (Wiltshire).

APRIL 14

With a depression over the North Sea a strong north-westerly airstream covered Britain. Thunderstorms occurred in eastern counties; during a heavy storm on Humberside the M62 Motorway was flooded near Goole while at Binbrook (Lincs) hailstones of 10 to 20mm diamter were reported.

APRIL 20

Following a short spell of spring-like weather a cold northerly airstream brought a sharp fall in temperature on the 20th accompanied by widespread snow and hail showers. During local thunderstorms in South Wales hail exceeding 10mm diameter fell at Penmaen (West Glamorgan).

MAY 1

A cool north-westerly airstream covered the British Isles, and showers were frequent in northern Britain. Hail of over 10mm diameter fell at Brodick on the Isle of Arran (Strathclyde).

MAY 26

Pressure was low to the west of Ireland while an anticyclone was situated over eastern Europe. A southerly airstream advected warm, humid air across Britain, and troughs embedded in this airstream brought thundery outbreaks northwards from France and Biscay. The first wave of storms crossed England in the early early hours of the 26th. A second area of storms reached central southern England

during the late morning and continued north-eastwards across south-east England and East Anglia during the afternoon. As temperatures rose to 24°C in parts of Kent and East Anglia, several storms turned violent with squally winds (reportedly to 63kt) and large hail. A severe hailstorm, Britain's worst since June 1983, left a 20 to 25 kilometre trail of damage across north-west Essex. The most severely affected area was north-west of Chelmsford, and included the villages of High Roding, Good Easter, Pleshey, Barnston, Great Dunmow, Little Easton and Great Easton.

At Great Dunmow hailstones of 34mm diameter were recorded. Damage was especially severe in the neighbourhood of Good Easter, where hailstones were described as being typically of golf-ball size. Glasshouses were shattered, some without a pane of glass remaining intact, while several stained-glass windows in the village church were holes. Cars had their windscreens smashed, paint removed, and bodywork pitted. Structural damage also occurred to houses with slates cracked and torn from roofs.

Around Good Easter and High Easter 80 farms suffered 50-75% loss of winter barley, wheat, oilseed rape, and beans. Individual farm losses reached to £50,000, and the total storm damage has been estimated at £1,500,000.

Some of the other storm cells that afternoon also produced large hail. At Basildon, South Essex, 10-13mm diameter hail was recorded, and at nearby Stanford-le-Hope much foliage was stripped from trees. Large hail was also reported from Charing in Kent.

The Chelmsford storm, about H5 in intensity, was probably the most severe hailstorm in the County of Essex since an H6 storm on 27th May 1913. On that occasion hail the size of hen's eggs caused widespread destruction of windows, tiles, and slate roofs between Halstead and Haverhill. Another severe hailstorm accompanied by a tornado affected Essex on 24th June 1897. Hail damage was reported along a 100km swath between Slough and Colchester, but the largest hailstones, the size of hen's eggs, were reported just south-west of Chelmsford (*Met. Mag.* 1897, pp.84-91). A more detailed report of the 1985 Essex storms is in preparation by Derek Elsom.

JUNE 5

Warm, humid air spread northwards over Britain on 3rd June and widespread thunderstorms spread from France on the 4th. A slack pressure gradient covered England and Wales on the 5th while a cold front over Scotland edged slowly southward to reach central England by midnight. The upper air charts show a broad trough to the west of the British Isles with a continuing flow of warm air northwards over southern Britain. As the surface cold front moved southwards a surface north-easterly airstream became established and this suggests that considerable windshear was initiated over southern England, fulfilling the conditions favourable for development of self-propagating storms.

Severe thunderstorms broke out between mid-Wales and Essex with a particularly severe-storm system producing intense rain and hail in north Berkshire and south Oxfordshire. A swath of hail damage was reported over the Berkshire downs between Swindon and Reading. At Warren Farm near Lambourn, 52.5mm of rain and hail fell between 1800 and 1930 GMT, 20mm

diameter hailstones fell heavily between 1815 and 1830, flattening 100 acres of winter barley. Some farm roads were blocked by hail drifts up to 45cm deep. During a cycle race in the same area several riders suffered cuts and bruises from hailstones described as being of golf-ball size.

Further east much damage to crops occurred in the neighbourhood of Chaddleworth. The storm commenced here at around 1845 and lasted for some 30 to 45 minutes. The hailstones, of pea-size but falling with exceptional intensity, caused damage amounting to £30,000 at Manor Farm, Chaddleworth. 70 acres of winter barley crop were severely hit with 90% of the stems severed or shredded, and the remainder considerably bent or bruised. Winter wheat and spring barley crops of over 130 acres were also severely bruised and cut. Comparable damage was experienced on other farms in the area. At nearby Beedon many gardens were completely ruined while at Compton congealed hail formed "ice-bergs" which floated down the flooded streets.

During the same outbreak of storms on 5th June large hail was also reported from Stroud in Gloucestershire.

JUNE 9

A cool showery north-westerly airstream covered the British Isles. A cold-front wave moved across northern France and an associated trough crossed southern England during the day. Showers turned thundery at several places in southern England and 16mm hailstones fell at Manston in east Kent.

JUNE 19

A shallow surface depression was situated over north-east France with a broad upper trough over western Europe. Thunderstorms affected parts of southern England, and large hailstones were reported from Linton in Cambridgeshire.

JUNE 24

A depression was situated north-west of Scotland and a distinct shallow trough moved eastwards over southern Britain. Thunderstorms broke out widely during the morning and persisted well into the afternoon in eastern counties. Hail fell in several places and hailstones the size of pigeons eggs were reported from the Ashford and Doddington area of Kent.

JULY 5

An anticyclone drifted from northern France on 2nd July to Scandinavia by the morning of 5th July, giving a spell of warm southerly winds. A cold front moved slowly across the British Isles on the 5th preceded by a shallow thundery trough. Afternoon temperatures reached 27°C in parts of eastern England. The 500mb charts show a strong ridge over Europe ahead of a marked trough approaching Western Britain. Thunderstorms were first reported in north-east Hampshire around midday, and they became severe as they crossed the London area and East Anglia during the afternoon and evening. Very intense hail fell in a narrow swath across Norfolk between Norwich and Bacton on the coast. At Dilham some hailstones, when measured and photographed, were fully 40mm in diameter. Farms suffered heavy losses; pea-pods were ruptured, sugar-beet leaves shredded, potato stems smashed, and cereal crops levelled. Greenhouses and house-windows were also broken by the hail and squally winds gusting to 77 mph. Cars and

caravans were dented and marquees shredded. A full account of this storm is given by C. R. Briscoe in *J. Meteorology,* vol.9, no.103, November 1985.

JULY 20

With a depression centred south-east of Iceland, a strong westerly airstream covered England and Wales. At 500mb a broad trough lay over the country. The day was very showery and thunderstorms developed in many parts of south-east England. At Loughton, Essex, no less than seven separate thunderstorms occurred between 1245 and 2100 GMT. Very intense pea-sized hail fell in the Lawford and Dedham areas of Essex. At Dedham the ground was described as white like snow. At Lawford a 15-minute storm of wind-driven hailstones, beginning at 1800 GMT, caused extensive damage to lettuce crops at a Salad Producing Co-operative. The hailstones were the size of peas but were driven by the strong squally winds into drifts up to 45cm deep. This was a good example of the combined effect of wind and hail on vegetation.

JULY 25/26

A report on hail damage in Ireland during this night of severe storms has already been published in *J. Meteorology,* vol.10, pp.370-372. A full account of the thunderstorms of this night has been prepared by Keith Mortimore (*J. Meteorology,* vol.11, 299-306, 1986).

The hail, up to at least 30mm diameter, caused extensive destruction of crops in the counties of Kilkenny, Kildare, Louth, Dublin, Neath, Antrim and Down. At Athy, Co. Kildare, 2,237 hectares of crops were destroyed at an estimated cost of over £1,000,000. The total cost of hail damage in the Republic of Ireland has been estimated at £3,000,000. In County Down, Northern Ireland, farm buildings were damaged by hail.

An examination of TORRO files for previous Irish hailstorms of the last century suggests that damage has never been known to be so extensive as in this H3 hailstorm. There have been occasions of locally more-severe storms, up to H5-H6 in intensity. On 4th January 1890 a hailstorm broke 70 panes of glass at Vilbane Church in County Clare. On 8th July 1906 hail the size of oranges fell near Ballinora, Co. Cork, accumulating to a depth of two feet, tearing bark from trees and flattening crops. On 19th July 1907 hailstones of 15cm circumference and weighing an ounce fell at Banbridge, Co. Down, causing much destruction of glass. Another storm on 21st July 1907 caused much damage to greenhouses in Londonderry. Recently, on 12th October 1982 hailstones up to 63mm in diameter fell at Tramore, Co. Waterford.

AUGUST 3

A quite strong, cool westerly airstream covered Britain with a depression centred north of Scotland. A deep upper trough lay just west of the country with an unusually strong south-westerly jet-stream over southern Britain. Showers quickly developed and by mid-day thunderstorms, some with hail, were being reported from as far apart as Cumbria and south Hampshire. During a thunderstorm at Crowmarsh Gifford, Oxfordshire, between 1117 and 1145 GMT some interesting conical hailstones were observed. These were up to 10mm diameter, opaque at the narrower end and transparent at the wide end.

During a severe thunderstorm at Compton near Winchester (Hampshire) hail accumulated to a depth of some 80mm, stripping leaves from trees. Intense hail also fell in the village of St. Cross during this storm which crossed the Winchester area between 1125 and 1215. The worst storm of the day occurred in the Marlow area of Buckinghamshire during the early afternoon. Hailstones up to 25mm diameter fell around Little Marlow and Woodburn Green. One market garden suffered damage to crops amounting to £100,000. Another farm in the area lost 95% of its oil-seed rape.

AUGUST 12

Pressure was low to the north-west of the British Isles and an unstable south-westerly airstream covered the country. Showers turned thundery in many places with local hail; hailstones over 10mm diameter fell at Long Sutton, Hampshire.

Table 1: Occasions of large or damaging hail in Great Britain and Ireland in 1985.

Date	*County*	*Intensity*	*Date*	*County*	*Intensity*
January 23	Merseyside	H1	June 19	Cambridgeshire	H1
March 14	Gloucestershire	H1	„ 24	Kent	H3
„ 15	Lancashire	H1	July 5	Norfolk	H5
„ 15	Staffordshire	H1	„ 20	Essex	H2
„ 15	West Midlands	H1	„ 26	Ireland – Kilkenny, Kildare, Louth, Dublin, Neath, Antrim, Down	H3
„ 15	Western Isles	H1			
„ 15	Fermanagh (Ireland)	H1			
„ 24	Leicestershire	H1	August 3	Hampshire	H2
„ 24	Gloucestershire	H1	„ 3	Oxfordshire	H1
„ 30	Co. Down (Ireland)	H1	„ 3	Buckinghamshire	H3
April 6	Wiltshire	H1	„ 12	Hampshire	H1
„ 14	Lincolnshire	H1	„ 13	Satffordshire	H1
„ 20	West Glamorgan	H1	Oct. 4	Cumbria, Dumfries & Galloway	H4
May 1	Strathclyde	H1			
„ 26	Essex (N.W.)	H5	Nov. 9	Berkshire	H1
„ 26	Essex (South)	H2	„ 9	Kent	H1
„ 26	Kent	H1	„ 10	Orkney	H1
June 5	Berkshire/Gloucester	H2/3	„ 27	Merseyside	H1
„ 5	Gloucestershire	H1	„ 27	Shetland	H1
„ 9	Kent	H1	Dec. 23	Gwynedd	H4

AUGUST 13

The synoptic situation was fairly similar to the preceding day although winds had backed more towards the south as a depression developed west of Ireland. During further heavy showers hail over 10mm diameter fell at Stone, Staffordshire.

OCTOBER 4

As usual by October the focus of convective activity shifted to Britain's warm surrounding seas. On October 4th a deep depression west of Scotland was drifting north-eastwards with a strong south-westerly airstream of polar origin over the British Isles. A deep upper trough was approaching western Britain. Showers, some thundery, were widespread throughout the day in the west and north. During a heavy early morning thunderstorm hail of over 20mm diameter was reported at Stainburn near Workington on the Cumbrian coast. This storm then crossed the Solway Firth and around 0700 GMT hailstones of over 20mm

diameter also fell just south-east of Collin, near Dumfries. The hail and accompanying strong winds caused many breakages among windows with a south-westerly aspect. The warm waters of the Irish sea were almost certainly the source of this particular storm.

NOVEMBER 9

The short but intense hailstorm which caused a pile-up on the M4 motorway near Newbury has been fully described by Bill Pike in *J. Meteorology,* vol.11, no.106, pp.51-55. It therefore suffices to note that this was another winter hailstorm, occurring in a returning maritime polar airstream. This particular storm cell was associated with a showery disturbance ahead of a deep upper trough approaching western Britain. Very intense hail up to 10mm diameter fell between Lambourn and Hungerford, especially near Great Shefford, but reports of huge chunks of hail appear to have been unsubstantiated by subsequent investigation. Thunder and hail were quite widespread over southern England on this day, and hail more than 10mm in diameter was later reported at Folkestone in Kent.

NOVEMBER 10

In an unstable arctic airstream hailstones over 10m diameter fell at Kirkwall, Orkney.

NOVEMBER 27

A depression was situated in the North Sea with a cold arctic airstream over the British Isles. Once again the warm Irish Sea was a source of convection, and during a thunderstorm at Heswall, Merseyside, hailstones up to 10mm in diameter were recorded.

Hailstones of over 10mm diameter were also reported from Lerwick in the Shetlands.

DECEMBER 23

A depression was situated near north-west Ireland with an unstable south-westerly airstream of polar origin over the British Isles. Much convective activity occurred over the warm Irish Sea and an early morning thunderstorm at Dolgellau, Gwynedd, was accompanied by golf-ball size hailstones. During the five-minute hailstorm roofs, windows, and car ports were damaged.

Acknowledgement.

The TORRO directors would like to thank all TORRO observers who sent in details of hailfalls; also observers of the Thunderstorm Census Organisation and Climatological Observers Link whose invaluable reports have been utilised for these summaries. Valuable information has also been available from the London Weather Centre's *Daily Weather Summary* and the *Monthly Weather Report* of the the Meteorological Office. Finally, and not least, thanks are due to members of the general public who provided additional eye-witness reports of the more severe storms.

Additional note on the Berkshire storm of 23 July 1984

This additional report is based on a detailed investigation by Stephen Burt of Sandhurst, Berkshire (personal communication).

An area of 10 sq.km. in east Berkshire reported hail of over 20mm diameter

with the largest hailstones observed in west Sandhurst (up to 40mm) and north-east Wokingham (38mm). Damage to vegetation was severe in Yateley, Sandhurst, Crowthorne, Bracknell, and Wokingham; outstanding features included the complete shelling of beans and the denting and even splitting of apples. Structural damage was relatively slight, although car-ports were quite extensively damaged, especially in Wokingham. There were also cases of putty being stripped from window frames and creosote removed fron wood. Surprisingly, there was only one reported instance of greenhouse glass being broken.

The level of damage disclosed by this investigation confirms that this particular storm rated about H3 on the TORRO scale. The detailed observation of the storm's development suggests that this was an organised multicell storm typical in an environment of moderate wind shear.

Corrections to The TORRO hailstorm intensity scale, J. Meteorology, issue no.114.

On page 338, second paragraph, read "reported hail up to marble size will be graded H1 to H4".

On page 339, Table 2, H-scale number 6, read "Many roof tiles/slates broken".

BRITANNIA WAIVES THE RULES

Miss Valerie Maltby broke a long-standing custom to become the first woman ever to sail as one of the meteorological staff on a UK weather ship when the Ocean Weather Ship CUMULUS left Greenock on Thursday 12th March. Valerie has a B.Sc. in Nautical Studies and works as a Scientific Officer in the Marine Enquiry section of the Meteorological Office, but despite this she had no practical sea-going experience, so the trip was arranged to give her a greater understanding of the weather problems facing mariners.

One of her main problems is getting her sea legs. The ship is to be at sea for a month with over three weeks lying stopped on station at 57°N 20°W, some 800km west of the UK. The long rolling Atlantic swell is a background to the storm-force winds which are common in the spring. Acclimatisation to the motion can take quite a long time. Her duties include hourly observations of the surface

weather conditions and, four times daily, launches of balloons carrying radio-sondes which contain meteorological instruments and a radio transmitter and give information about winds, temperatures, humidity and pressure at upper levels. Other routine tasks include sea temperatures to depths below 900 feet, and recording sightings of sea-birds, whales, dolphins and blackfish for University projects. Leisure time can be spent watching the pre-recorded TV programmes and video films which the ship carries for on-board entertainment.

The first of the Meteorological Office's weather ships, in 1947, was one of the Flower Class corvettes immortalised in Nicholas Monsarratt's 'Cruel Sea'. CUMULUS herself was bought in 1985 from the Royal Netherlands Meteorological Institute for the symbolic sum of £1.00. For further information contact the Marine Superintendent, Captain Gordon Mackie, on 0344 484961 (London Road, Bracknell, Berkshire RG12 2SZ).

FROST

By the breath of God frost is given.

Job 37, v. 10

Now there is frost upon the hill
And no leaf stirring in the wood;
The little streams are cold and still
Never so still has winter stood.

George O'Neill, 'Where it is Winter'

The frost performs its secret ministry
Unhelped by any wind.

S. T. Coleridge, 'Frost at Midnight'

Fine as ice ferns on January panes
Made by a breath.

Tennyson, 'Aylmers Field'

What miracle of weird transforming
Is this wild work of frost and light
This glimpse of glory infinite?

J. G. Whittier, 'The Pageant'

Motionless torrent! Silent cataracts.

S. T. Coleridge (1772-1834)

IN PRAISE OF METEOROLOGISTS

'While the geologist yearns for the mountains, the botanist for the field and the mathematician for the study, the meteorologist, like a spirit of a higher order than any, rejoices in the kingdom of the air.'

J. Ruskin (1819-1900)

(Verses supplied by Mr. Paul Spink (Ulceby, Humberside))

WORLD WEATHER DISASTERS: October 1986

1-2: Heavy storms and floods in northern Tunisia left 20 dead and thousands homeless. *Daily Telegraph.*

1-10: Torrential rains and floods in eight mid-West states of U.S.A.; worst hit were states of Oklahoma, Illinois, Missouri and Kansas, up to 55,000 people forced from homes because of floods, 30,000 in Oklahoma alone, up to 600mm of rain fell in areas during a one week period. Damage in Illinois put at $40,000,000, with eight weather-related deaths, with another three missing; floods in Illinois and Oklahoma described as worst in those states' history. On the 7th the River Missouri reached a height of 11.5 metres, which is more than 3.6 metres over flood stage, at St. Charles, Missouri. *Lloyds List, International Herlad Tribune.*

1-15: Monsoon rains and floods in many areas of Bangladesh, at least 120 people died and over 1,000,000 others made homeless; the floods affected more than 6,000,000 people, killed 7,000 cattle and destroyed 300,000 hectares of rice and other crops. *L.L.*

2: Storm, lasting five minutes hit Sydney, Australia, with golfball-sized hail that caused £10,000,000 damage. At least seven people suffered head injuries. *Birmingham Evening Mail.*

4-5: Heavy thunderstorms and floods in south-east Spain left four dead, storms and floods in provinces of Valencia, Alicante and Murcia, many towns and villages isolated, in Alicante province the River Segura overflowed its banks near the town of Orihuela. *L.L.*

4 (reported): Serious drought in Henan province, China, 80% of autumn grain crop affected. *L.L.*

6: Fog affected motorway between Milano and Piaceriza, Italy, accidents in the thick morning fog left three dead and 30 injured. *D.T.*

6-7: Tropical depression "Oyang" moved across Luzon, Philippines, causing widespread floods, which left at least 13 dead and 11,500 people forced from homes; floods in areas of Manilla reached a depth of 2.14 metres; in the 24 hours ending in morning of the 6th 320mm of rain fell on Manilla, other areas of Luzon reported 483mm of rain on the 6th; apart from Manilla, floods reported in provinces of Zambales, Pangasinan, Nueva Viscaya, Quezon, Laguna, Cavite and Batangas. *L.L.*

6 (reported): Avalanche on Mt. Lhotse, Tibet, left one dead. *B.E.M.*

7: Renewed storms in northern Tunisia left at least four dead. *D.T.*

8: F.v. *Kyeong Yang No.3* sank in high seas whipped up by 90 km/h winds some 325km off Hokkaido islands, Japan, leaving 25 dead. *L.L.*

8-16: Floods in Assam state, India, left at least 14 dead, made 150,000 homeless and caused damage worth $300,000,000, $70,000,000 of which was to crops after seven tributaries of the Brahmaputra river overflowed and flooded 300,000 hectares of land. *L.L.*

10-12: Torrential rains, accompanied by strong winds and high tides hit southern areas of Alaska, U.S.A.; damage in Seward and near Talkeetna put at $21,000,000, over 350mm of rain fell in areas in most destructive storm in south-central Alaska in 10 years. *L.L., I.H.T.*

11-13: Heavy rains and landslides in Purwokerto area, central Java, Indonesia, floods in four villages in the Purbalingga area left two dead on the 13th, a landslide the same day at a village in Purworedjo left nine dead, five injured, over 30 houses destroyed in village, thousands of hectares of rice fields flooded. *Jakarta Post.*

11 (reported): Drought, described as the worst in a century, still affecting much of eastern Alabama, Georgia, western North Carolina and eastern Tennessee, U.S.A. *I.H.T.*

12-15: Violent thunderstorms lashed south-east Spain on 12th/13th, leaving at least two dead; accompanying floods cut rail and road links and disrupted telephone and power lines; on the 15th a violent storm in Motsil, near Granada, southern Spain left three dead in flash floods. *L.L., D.T.*

13-14: Heavy rains touched off a landslide which partially blocked the Panama Canal, the landslide occurred in Cucaracha Reach, south of Gold Hill in Gaillard Cut, canal traffic reduced to a single lane. *D.T.*

19-20: Snowstorms, with winds up to 151 km/h, in the Swiss Alps, traffic disrupted over several mountain passes. *D.T.*

19-20: Gales in southern England, two motorists died when winds brought down trees on to their cars on the 20th, one in Eltham, south London, the other at Morden, south-east London; the previous day, 19th, a speedboat disappeared near Rathlin Island, off North Antrim coast, Northern Ireland, in rough seas, all four aboard feared drowned. *D.T.*

Fig.1: The Oxford Polytechnic Wheatley car park at 10 a.m. on Monday 20th October 1986 (photograph by Eric Boone).

21 (reported): At least four people died of cold in the Pirparijai Mountains of south-west Kashmir when hundreds of nomadic graziers and their cattle were trapped by snow in the mountains. *D.T.*

23: Heavy rains and floods on Ile De La Gonave, Haiti, left at least 30 dead and 13 missing, several thousand people forced to leave their homes on the island. *L.L., I.H.T.*

24-31: Torrential rains and floods in southern Lampung province, Sumatra, Indonesia; worst of floods on evening of 25th, floods and landslides left 88 dead and 20,000 homeless, 26 died in Padasuka district 21 in Padang Cermin district and 7 dead in Cukun Balak district, with many others missing (some later found dead, raising figures to 88), floods destroyed at least 28 homes and damaged 2,112 others, coffee and rice crops heavily damaged. *J.P., L.L.*

28: Heavy rain flooded large areas of San Salvador, El Salvador; River Acelhuyate, which runs through city, overflowed its causeway, washing away shelters built on its banks to house people made homeless by the October 10th earthquake; flooding appeared to be worst in the Mejicanos neighbourhood, where a bridge was seriously damaged. *L.L.*

ALBERT J. THOMAS

THE SNOWFALLS OF 11th-14th JANUARY 1987 IN SOUTH-EAST ESSEX

Abstract: Depth of snow measured in the writer's garden in Thundersley, Essex on January 12th was easily the greatest seen in 46 years of observations, mostly in the Chiswick and Twickenham areas, but only since June 1984 at the above address.

The ensuing notes comprise: (1) An attempt to put the recent snowfalls and low temperatures into perspective for this district against a background of local records. (2) A short account of the minutiae of life during the snowfalls, rather than the effects on transport which have already been dealt with by the media. (3) A few reflections on recent winters.

OWN OBSERVATIONS AT THUNDERSLEY

Altitude 70 metres: position about 7km north of the Thames Estuary and 10km W.N.W. of Southend-on-Sea.

Note on rainfall readings: The gauge is free-standiing and not partially sunk in ground, consequently the rim stood above the snow level. Inevitably the funnel was overwhelmed by the fall of the 11th/12th and this reading at least must be regarded as an underestimate. The gauge was brought indoors to thaw out each day during intervals between snowfalls.

Sunday, 11th January (all times GMT)

Increasingly heavy periods of snow during the morning resulted in 7cm depth by noon, and after a brief brighter interlude further showers increased the level to 10cm at 18h, by which time the wind which had been N.E. force 3 (Beaufort) fell light and skies cleared. Screen temperatures: Maximum –3°C, Minimum –9°C (latter figure when instruments were reset at 19h). Precipitation (melted snow, from 19h, 10th to 19h, 11th) 4.8mm.

Monday 12th January

Snowfall during the night increased the level depth to 38cm, exceeding the previous deepest seen (29th December 1962, Richmond Hill, Surrey) by 9cm. There was little sign of drifting. The day was cloudy with only a few snow flurries and a brief appearance of the sun between fibrous cumulonimbus about midday. Temperatures: Maximum –7°C, Minimum –12°C, being the lowest and equal lowest respectively in personal records. Precipitation (melted snow, read at 12h) 11.9mm (see note above).

Fig.1: Snow in Thundersley, Essex, 12th January 1987, photographed by R. W. Selfe, compared with the same scene after the snow had cleared.

Tuesday 13th January

Dull with continuous and at times heavy snow during morning, petering out after lunch but producing a depth of 46cm by 18h (winds N.E. force 3). Temperatures: Maximum -5°C, Minimum -9°C. Precipitation (melted snow): (read at 19h) 13.2mm.

Wednesday 14th January

Continuous slight snow during the morning only, but winds now increased to N.E. force 5-7 causing drifting of lying snow to, for example, 70cm in garage drive. Temperatures rose gradually during the day: Maximum -3°C, Minimum -6°C. Precipitation (melted snow), 4.3mm. Total for 4 days' snowfall = 34.2mm.

SHOEBURYNESS METEOROLOGICAL OFFICE

Altitude 2m. Situated on coast about 7km east of Southend.

Snowfall: Maximum level depth on 13th, 38cm. Severe drifting occurred at this exposed site on the 14th. Temperatures on 12th: Maximum -5.6°C, Minimum -11.6°C. The maximum was the lowest in records started in 1921, the previous lowest being -5.0°C on 1st February 1956. The value of -5.6 was reached when the readings were made at 9h on the 13th, and the actual maximum during daylight on the 12th was -8.9°C. The minimum almost equalled the lowest ever (-11.7°C in 1926).

SOUTHEND-ON-SEA WEATHER STATION

Situated on low-lying level ground near the sea-front about 1km east of town centre. Observation taken at 9h.

Snowfall: Maximum level depth on 14th 55cm. Greatest fall in 24-hours 23cm (12th). Temperatures on 12th, Maximum -6°C, Minimum -10°C. Rainfall: 11th 6.1mm, 12th 12.3mm, 13th 5.1mm, 14th trace.

Observers at both the above stations reported great difficulties in getting to their posts and in making measurements.

SOUTHEND AIRPORT

Volmet reports gave temperatures between 16h and 17h on 12th as -12°C followed by a rapid rise to -9°C.

EFFECTS ON LOCAL COMMUNITY

Thundersley consists of about 4 sq.km. of residential streets interspersed with common and woodland. Sandown Road is normally much used as a cut-through by traffic to and from the busy Rayleigh Weir roundabout on the arterial Southend to London A127 road, but as no attempt at snow clearance was made for a further seven days, few vehicles passed. Milk was not delivered for more than a week in most parts, and news of where the dairy floats had set up shop was passed by word of mouth, together with other local messages as shoppers trudged along the vehicle tracks in the roads. One kindly soul came along pulling a sledge with several bottles of milk for anyone in need. The advantage of taller boots soon became evident when stepping aside for the rare car to pass. Ordinary gumboots of 36cm soon confirmed the depth at a level 38cm!

The district is fortunate in possessing a large Sainsbury's supermarket within walking distance, and its personnel were very commendably able to keep it fully operational. More active people collected shopping for the less able and there was more than a hint of a long-forgotten wartime spirit! No post arrived at the local Sorting Office until Thursday and our postman arrived on foot the next day making several trips to clear the backlog. Newspapers failed to appear at all on Monday the 12th, and Tuesday's arrived at noon. Doubtless taking advantage of school closures, newsagents pressed their young delivery staff into action for an afternoon distribution. A striking feature of the cold spell was the array of lengthening icicles hanging from all the gutters, and a number of gutters succumbed to the strain. Temperatures remained continuously at or below freezing until the 20th and large piles of snow and ice still remained scattered around the pavements until well into February.

COMMENT

Manley (1961) considered that it was very rare to receive 10 inches (25cm) of snow in a single fall on low ground, but this appears to have been achieved in this area on 12th January 1987. Local opinion seems to agree that this was the greatest fall since 1947, but no-one could recall the depth in that winter, and Shoeburyness Meteorological Office had lost many records in the East Coast Floods of 1953, possibly including that information.

THE LAST FEW WINTERS

In view of the publicity frequently given to an expected global rise in temperatures due to a build-up of carbon dioxide in the atmosphere (the "Greenhouse Effect"), a glance at statistics relating to recent winters in S.E. England show something of a reverse tendency. A computer analysis of the number of days with maxima 0.4 deg. C or below in each winter at Heathrow or Kew before 1981 showed up the following facts: In the recent winter, and in each of 4 out of the 8 previous ones (December-February), there were 7 or more such days, whereas in the 16 winters prior to 1978/9 only one achieved this number, namely 1962/3.

As an amateur observer the writer can only pose the following questions:

1. Have other countries achieved the decrease in amount of solid particles discharged into the air resulting in the absence of "smog" since the early 1960's here? Surely clearer skies in the long winter nights result in greater heat loss by radiation?

2. To what extent do economics in heat loss from both domestic and industrial buildings mean less warming from this source of the lower layers of the atmosphere?

3. How far has deforestation in the northern continents affected the albedo of the earth's surface with a consequent tendency towards harsher extremes of climate?

POSTSCRIPT. When lunching out the other day it was amusing to hear that one of the times yearned for in a song about "the good old days" was "when the winters used to be warmer"!

ACKNOWLEDGEMENTS. Special thanks to Mr. Norman Washburn of Southend Weather Station who showed me copies of his reports; also Shoeburyness Meteorological Office for their readiness to furnish information on request, and to Heathrow Airport Meteorological Office for permission to quote from data supplied from their observations.

REFERENCE

G. MANLEY (1961): *Climate and the British Scene.*

69 Sandown Road, Thundersley, Benfleet, Essex. R. W. SELFE

LETTERS TO THE EDITOR

AN OBSERVER'S WIND-CHILL EXPERIENCE, 13 JANUARY 1987

The most severe conditions this winter occurred on 11th, 12th and 13th January. The maximum of −6.6°C on the 11th was the lowest on record for the station (records began in 1977) but this was broken again next day witha 24-hour maximum of −8.0°C (12-hour daytime maximum of −8.5°C). Minima too at this upland station reached record low levels with −10.3°C on the 12th and −10.9°C on the 13th. The low temperatures were compounded by an increasing north-east wind which early on the 13th gave wind-chill values between −30°C and −40°C. The observer had the unpleasant experience of his nose becoming blocked by ice while taking the wind-speed observations and has subsequently lost the skin from the ends of four fingers on his right hand despite wearing gloves when holding the anemometer. This cold spell was accompanied by a heavy snowfall on the 13th and 14th, the mean depth of undrifted snow measuring 40cm and the depths of drifts reaching and surpassing 2 metres. The severe cold ended on the 19th after 11 consecutive freezing days, but drift remnants persisted until 8th February.

Middleton, Derbyshire. David F. EVANS

THE JANUARY COLDWAVE IN NORTHERN ITALY

L' arrivo di una intensa ed estesa perturbazione Atlantica in concomitanza con un preesistente cuscinetto di aria fredda determinato da precedenti afflussi di aria di origine Artica, ha provocato dal 10 al 15 Gennaio 1987 precipitazioni estese, persistenti ed intense a carattere nevoso sull'Italia del Nord, in particolare sulla Valle Padana e Appennino Centro-Settentrionale con notevoli disagi al traffico stradale, comuni isolati dal notevole spessore della neve che a Milano ha ragguinto i 30 cm, Piacenza gli 85 cm, a Parma i 50 cm, a Reggio, Modena e Bologna i 30-40 cm. Sull' Appennino Modenese in Val di Luce i 160 cm, 90 cm al Passo delle Radici, dai 70 ai 90 cm sul Monte Cimone, 100 cm al Passo della Cisa, dai 70 ai 100 cm sull'Appennino Reggiano.

Le temperature si sono mantenute a livelli molto bassi con minime di −8°C a Venezia e −20 a Dobbiaco. A Trieste la Bora ha ragguinto raffiche di 130 km/h con danni ai tetti delle abitazioni e alle strutture del Porto. Nei giorne successivi dal 16 al 18 Gennaio, le precipitazioni nevose si sono

concentrate sul Piemonte, Liguria e Lombardia; a Torino la precipitazione si éprotratta per 50 ore e il manto nevoso ha raggiunto i 50 cm e superato gli 80 cm sulle zone piú alte. La neve é caduta anche sulle Riviere Liguri e a Genova ha raggiunto i 10 cm. Le abbondanti precipitazioni hanno posto fine al lungo periodo di siccità che in alcune regioni Italiane aveva fatto scattare il piano di emergenza per calamità naturali. Molti Bacini Idro-elettrici si trovano a livelli di magna eccezionale e anche il Fiume Po aveva fatto registrare una magra record che non si avava da piú di un secolo nella stagione Invernale.

In alcune zone dell' Emilia Romagna nei giorni 21 e 22 Gennaio si sono registrate temperature decisamente polari con minime di −14.5 e −12°C a Piacenza, e di −11 a Reggio Emilia. La nebbia molto fitta nel tratto autostradale Piacenza-Fiorenzuola ha provocato una serie di temperamenti a catena nei quali sono rimasti coinvolti piú di un centinaio di autoveicoli con diversi feriti.

Casalecchio, Bologna, Italia. Mario DELMONTE

EARLY SPRING FOR SPAIN, LATE WINTER FOR TURKEY AMD GREECE

The very end of February and the first few days of March 1987 produced record or near-record high temperatures in the Canary Islands, Morocco and Southern Spain. The table compares 1200-hour temperatures (usually not the maximum recorded) reported in the press, with record absolute maxima where known. The latter were obtained from a number of sources, but principally *Weather in the Mediterranean* (HMSO 1964) and E. Pearce and C. Smith *The World Weather Guide,* Hutchinson, 1987

Station	*Absolute Maxima (°C) on Record for*		*1200 readings 1987*
	February	*March*	*(date in brackets)*
Malaga	26	29	27°C (3rd March)
Almeria	25.5	26.5	not available
Valencia	25.5	30.5	25°C (2nd March)
Las Palmas	29	30	29°C (3rd March)
Tenerife	29	36	28°C (3rd March)
Faro	22.5	26	24 (1st March), 26 (3rd March)
Tangier	not known		26°C (28th February)
Gibraltar	26	27	26°C (4th March

Considering that these temperatures were noted in the first few days of March and are not maxima, it is clear that they represent exceptionally high values for the time of year. A surface anticyclone over Spain with warm advection on its western flank accompanied the high temperatures with a major upper ridge extending from Spain to the North Sea.

At the other end of the Mediterranean, in Turkey, early March brought heavy snowfalls (reportedly the worst for 25 years) as extremely cold continental air moved southwards in the rear of a depression over southern U.S.S.R. On two consecutive days, Istanbul reported −4°C at 1200 hours (5th-6th March). After a week of intermittent snow (to the 8th) nearly a metre of snow had fallen in Istanbul. The number of dead in Greece had reached 30 by 15th March, with 159 missing, on account of the heavy snow which cut off hundreds of mountain villages and small towns.

University College of Swansea. A. H. PERRY

ATTITUDES TO SNOW

(With reference to the article by G. A. Southern in *J. Meteorology,* no.115, January 1987, p.27)

It is interesting to consider how our attitudes to snow change as we go through life. The smallest infant knows nothing of it; the school-child thoroughly enjoys it; the young adult is not interested one way or the other (at that time of life there are other things more engaging than the weather to occupy the mind); in middle age we begin to find it a nuisance; and in old age we positively hate it (even fear it), although in the "last scene of all" we again become oblivious of it, as in earliest childhood.

Exceptions to this general pattern pertain to certain particular groups; weather enthusiasts, for example, often retain, all through life, a sort of childlike fascination for snow combined with a grown-up sense of reverential wonder at its form and beauty; other people of an aesthetic nature – literary

intellectuals, poets, landscape artists and photographers – also keen 'outdoor' types (country-lovers, walkers, ramblers, etc.), may view a snowfall as impressive or stimulating or exhilarating. It should be said, though, that the luxury of being able to indulge a positive attitude to snow usually relies on the provisos of (a) having the choice of whether or not to go out in it, and (b) being affluent enough to be able to keep the home (bedrooms and all) heated up to 65 or 70 degrees Fahrenheit, in defiance of the cold outside, and with never a care about the forthcoming gas bill (or whatever) due in March. The snowscape surely loses much of its beauty in the eyes of those who must go out into it in conection with their work, or those whose circumstances are such that they have to return to, or look out at it from, a cold, inadequately heated, home.

Undoubtedly, much of the interest that a snowfall arouses in this country has to do with its comparative rarity (in lowland Britain, at least); I cannot imagine that people native to countries where winter snow-cover is the rule rather than the exception are capable of romanticising about it as we sometimes do. Even here, I think it is only on the novelty of a fresh snowfall that we generally get excited about it; if it lingers on the ground for more than a few days it becomes ordinary, and we begin to weary of it, especially in urban areas where it so quickly loses its pureness, and becomes just a hideous brown/black mush by the roadside.

For me, while I can certainly delight in the splendour of freshly-fallen snow under a cloudless morning sky – the more so if I have no essential journey to undertake – on balance, I should say it is a pleasure that is more than outweighed by the hardships it creates; (in southern Britain, in any case, a snowfall is more likely to be followed by a grey sky and a little freezing drizzle, before the slow thaw sets in – and there is not much joy to be had from that). I hope it does not seem that I take the role of a killjoy with regard to snow. It is reasonable that people in suitably propitious circumstances, who can enthuse about the favourable aspects of snow, should do so; I merely make the point that one should not be puzzled or critical if others, in different situations, are unable to show a similar level of appreciation for it.

12A Atlas Road, Bedminster, Bristol. Paul R. BROWN

WET AND DRY IN LAKELAND

Among several exceptional months in the last year and a half February 1986 was almost the driest and December 1986 one of the wettest ever recorded in Cumbria.

East or north-east winds in the Lake District result in long, totally dry spells with the west coast benefitting most. In February 1986 these conditions lasted throughout the month; many parts of west Cumbria had monthly precipitation totals under 2mm and a number of gauges reported nil. Several such gauges were read weekly or monthly and there must be doubt about these readings as small quantities of snow would sublime. The most reliable daily gauges did all record measurable precipitation but daily gauges recording nil included Ulverston and Sellafield. Gauges up in the western fells, too, had less than 5mm and the Coniston total (3.4mm) was 2% of average. In fact Coniston has had only 4 months with under 10mm since 1910:

February 1932	1.5mm
February 1986	3.4mm
April 1980	6.1mm
April 1974	7.7mm

In complete contrast Atlantic fronts and depressions continued almost without interruption from mid-October until the end of the year and in December 1986 many Cumbria raingauges had new record amounts. Monthly gauges with more than 700mm (yes 28 inches!) included Wrynose 808mm, Ullscarf 717mm and Mickleden, Langdale 700mm. Several daily gauges exceeded 500mm: Hartsop 536mm, The Nook, Thirlmere 525mm, Coniston 519mm, Elterwater 515mm and Grasmere 513mm. By a narrow margin this was the wettest *December* of the 78-year Coniston record but it has been exceeded by 8 other months:

month	*mm*	*inches*
October 1967	607	23.90
January 1928	600	23.64
October 1938	598	23.55
November 1929	596	23.47
November 1928	571	22.48

month	*mm*	*inches*
September 1950	539	21.23
September 1918	520	20.48
October 1954	519	20.41

The 3 months October-December 1986 gave Coniston 1318mm, this being the third wettest such period behind

October-December 1954	1465mm
October-December 1929	1388mm
October-December 1986	1318mm

To those of us with memories of dreadful Lakeland summer weather, August 1985 holds the Coniston record with a mere 446mm, whilst the wettest May (1920) had only 263mm.

31 Campbell Road, Edinburgh. Robin CUTFORTH

TEMPERATURES AT SCOTT BASE, ANTARCTICA, 1986

The following table gives the temperature for Scott Base, latitude 77°S, longitude 167°E, altitude 16 metres above mean sea-level, for the period February to December 1986. The data are taken from the monthly issues of the *New Zealand Gazette.*

	Mean Maximum	*Mean Minimum*	*Mean Temperature*	*Diff. from normal*	*Maximum (date)*	*Minimum (date)*
February	−4.8	−13.9	−9.4	+1.3	−1.1(5)	−22.0(19)
March	−14.5	−23.3	−18.9	+1.5	−2.1(2)	−34.5(30)
April	−17.2	−29.1	−23.2	+0.9	−6.5(30)	−45.0(16)
May	−16.4	−23.4	−19.9	+7.3	−9.6(1)	−34.7(7)
June	−19.9	−30.0	−25.0	+1.3	−8.5(17)	−43.7(29)
July	−22.0	−35.5	−28.8	+0.5	−9.6(30)	−44.1(1)
August	−26.5	−40.5	−33.5		−18.0(17)	−51.6(6)
September	−29.6	−42.8	−36.2		−16.7(8)	−50.7(3)
October	−15.3	−26.6	−21.0	+1.7	−7.5(25)	−40.8(1)
November	−8.3	−15.8	−12.1	−0.2	−3.4(11)	−23.3(5)
December	−1.7	−9.1	−5.4	+0.1	+3.3(9)	−14.5(1)

DAMAGING SPRING HAILSTORMS IN NEW ZEALAND

Two spring hailstorms within ten days of one another ravaged crops in the Hawkes district of New Zealand's North Island.

On Saturday, 18th October, 1986 the Hastings-Taradale area experienced its worst hailstorm since at least 1948. Mr. Garry Mulvanah of Otatara Heights described the storm: "The hail just swept over the Taradale Hills with a clap of thunder. Within half a minute solid sheets of hail were falling . . . everything in my garden was stripped . . . in ten minutes." With the hail accumulating to a level depth of at least 25mm local children even built a snowman – which is never a common sight in Hastings! The storm swath, at least 300 metres wide, devastated 1015 hectares of fruit and crops including 445 hectares of pipfruit, 157 hectares of stonefruit, 81 hectares of grapes, and 60 hectares of kiwifruit. Leaves were completely shredded, some kiwifruit looking as if a slasher had been driven through them with whole spurs knocked off. Widespread damage also occurred to berryfruit, apples, corn and asparagus, the total loss of revenue amounting to some $20,000,000.

Nine days later, on Monday 27th October, another hailstorm caused 60% damage to some orchards in Havelock North, south-east of Hastings. Coincidentally the area had sustained a comparable storm on exactly the same date in 1985. The storm of 18th October 1986 provides a good example of the vegetation damage which a H3 hailstorm can inflict (cf TORRO hailstorm intensity scale, *J. Meteorology,* vol.12, no.114, 337-339). TORRO is grateful to Mr. Bob Crowder of Lincoln College, Canterbury, N.Z. for providing details of these storms.

J. D. C. W.

OBSERVATIONS OF SPIRAL-CIRCLES IN THE YEARS 1936-1940

When my brother-in-law Mr. Evan Scurlock and his family who live in Aberystwyth visited Andover last Christmas they called in to see us. In passing I showed them some photographs of a single circle in a wheat field. Whereas Evan had heard of my interest in a strange phenomenon, this was the first time that he realised what it was all about. His reaction on seeing the first picture was "I have seen circles like this several times in a field near my parents farm before the last war, sometime between 1936 and 1940."

He had always thought that they had been formed by whirlwinds. He recalls an aeroplane crashing not far off in an adjoining field at about the time he first saw the circles. It is possible that the Civil Aviation Authority could provide the date for the air crash which could have been in the summer of 1936.

The location was a field of cereal crops, altitude 100-110 metres above sea-level grid reference SU 230520, in something of a south-facing combe on the edge of land rising steeply to the north. This hill is a part of a long ridge which includes Pepperbox Hill (near Whiteparish) in south Wiltshire. Beyond the hill to the north of the 'circles field' the land drops sharply again from about 150 metres above sea-level to 85, so the 'circles field' would be in the lee of winds coming from the north to north-west.

Evan saw circles on several occasions in this same area, but never on his parents farm a few kilometres away. The diameters of the circles were thought to approximate to the range 15 feet to 15 yards. He thinks there were two in the same field in one of the summers.

57 Salisbury Road, Andover, Hampshire. Colin ANDREWS

LITERATURE REVIEWS AND LISTINGS

Literature Listing

This is the first in an occasional series of listings each of which will provide a selection of not more than 10 useful references on a given meteorological/climatological topic. It is hoped that this series will help overcome some of the problems created by the present rather disorganised attitudes towards the publication of scientific literature and thereby make it easier for people to gain some basic information about topics with which they are unfamiliar. In the first list we provide a selection of 10 references on documentary archives as a data source for the study of *climatic history.*

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4. LANDSBERG, H. E. (1981) Past climates from unexploited written sources. pp51-62 in: Rotberg R. I. and Rabb T. K. – Climate and history: studies in interdisciplinary history. *Princeton University, Princeton, New Jersey,* 280pp.
5. LANDSBERG, H. E. (1981) Using early weather records: an untapped resource in climatological research. *Weatherwise, 34(5),* 197-203.
6. MANLEY, G. (1981) The use of archives and written records in meteorological research. *Archives, 15(65),* 3-10.
7. MOODIE, D. W., CATCHPOLE, A. J. W. (1975) Environmental data from historical documents by content analysis. *Manitoba Geographical Studies, 5,* 119pp.

8. OLIVER. J. (1958) The use of weather diaries in the study of historic climates. *Weather, 8(8),* 251-6.
9. PFISTER, C. (1984) The potential of documentary data for the reconstruction of past climates. Early 16th to 19th century. Switzerland as a case study. pp.331-7 in: Mörner N.-A. and Karlén W. (eds.) – Climatic changes on a yearly to millennial basis. *D. Reidel Publishing Company,* 667pp.
10. POTTER, H. R. (1978) The use of historic records for the augmentation of hydrological data. Report No.46, *Institute of Hydrology, Wallingford, Oxon.,* 55pp.

L. T.

TORRO TORNADO REPORT: July and August 1986

July was the most active month of 1986 so far for whirlwinds, with one tornado and three funnel clouds; there were also four reports of land devils.

FC1986July7. *S.W. of Springfield, Chelmsford, Essex (c TL 6601)*

A small funnel cloud was seen by Mr. Wayne Greig at 1534 GMT. The funnel, which lasted eight minutes, was hanging from the base of a very dark cloud; it did not reach the ground. No thunder or lightning was observed from the cloud. From a photograph taken by Mr. Greig the funnel cloud, which was S.W . of Springfield, appears to have been about 8-10km away and therefore near TL 6601.

A westerly flow covered Britain both at the surface and at 500mb. Southern districts had showers, mainly light, in the afternoon.

FC1986July14. *Abingdon, Oxfordshire (SU 4997)*

At about 1630 GMT a funnel cloud was seen at Abingdon just prior to a heavy shower. A brief burst of heavy rain was reported from between Cumnor and Faringdon about the same time (report from Jonathan Webb, who added that he noted extensive banks of cumulus, but with unglaciated tops, in the direction of Abingdon at about the time of the funnel cloud).

A W. or S.W. airstream covered most of Britain. An anticyclone affected southern areas, and maximum temperatures were about 25°C over most of England, but there were showers later on in the south Midlands and central-southern England, some of them quite heavy. At 500mb Britain was covered by a ridge.

FC1986July23. *Barmouth, Gwynedd (SG 5815)*

This funnel cloud appeared about 2-3 miles (3-5km) W. of Barmouth, stretching down about 750 feet (roughly 250 metres) from the base of a cumulonimbus at 2000 to 2500 feet (600 to 750 metres). The funnel had decayed considerably within two or three minutes, and disappeared before reaching land. There was a moderate covering of cumulonimbus at the time; the wind was N.W., force 5; a shower from the cloud was visible after the decay of the funnel, but no thunder or lightning was observed (information from Robin Harper).

23rd July was a cool day with N.W. winds around a complex low extending from the North Sea to N. Germany and S. Scandinavia. At 500mb there was a pronounced low off the coast of N.E. England. It was a very showery day, with a

great deal of hail and thunder. Some of the hail was quite large (*Climatological Observers' Link,* July 1986, Station Notes).

TN1986July30. *Dungannon, County Tyrone*

Around 1615 GMT on 30th July Dungannon was struck by a T2-3 tornado "with a sucking and roaring sound like a huge helicopter". Mr. Fin McCaul said the tornado "had a smoke-filled centre and was about ten feet in height and seemed to hover a few feet above the ground". Another eye witness described the tornado as being like "swirling smoke". Tiles were ripped off Mr. McCaul's house and a 600 gallon tank was lifted over a washing line. A corrugated iron structure at the UDR centre nearby was ripped apart and several trees were uprooted. The tornado then disappeared in the direction of Coalisland, which indicates that it was travelling roughly from S.W. to N.E. There was heavy rain at the time, with flooding in some places (*Courier and News,* 6th August; Belfast *Newsletter,* 31st July, sent by Mr. I. McNeill). Mr. McNeill saw the funnel cloud of the tornado from Cookstown, 14km to the north of Dungannon, at 1615 GMT.

An active low moved N.E. to be over Northern Ireland (998mb) at 1800. The tornado occurred several hours after the passage of the cold front, but not on the bent-back occlusion, which did not reach the area until several hours after the tornado occurred. At 500mb a pronounced trough lay to the west of Ireland.

Land devils in July 1986

Four reports of land devils have been received for this month:
LD1986July12. Fair Isle (HZ 2171). Mr. D. Wheeler, *COL,* July 1986, p.14.
LD/RS1986 July15. Marlpool, Derbyshire (SK 4345). Various newspapers.
LD1986July20? Hopcott, Somerset (SS 9645). *Sun.,* 21st July.
LD1986July22. New Milton, Hampshire (SZ 2495). *Lymington Times,* 26th July, 2nd August.

Conditions were anticyclonic on 12th and 15th. There was a westerly airstream on 20th and a north-north-westerly on 22nd.

August 1986 was a cold, wet and very unsettled month, but only one tornado was reported. A waterspout was observed from Tiree. Land devil activity was rather low for August, as conditions were rarely suitable.

WS1986August1. *Tiree, Strathclyde (NL 9944)*

The Shipping Forecast broadcast at 1355 BST on 1st August mentioned that a waterspout was seen at Tiree at 1100 (information from Mr. F. G. Thomas).

An unusually deep depression for the time of year (978mb) was S.W. of Ireland at 1200 GMT, while Tiree was in a ridge on its N.E. side. At 500mb an extremely large trough covered most of the N.E. Atlantic, with a small low S.W. of Ireland and a ridge over Britain. Scotland had broken cloud during the morning, with showers in the north.

TN1986August22. *Winkfield, Berkshire (SU 900740)*

Mr. P. M. Fishwick saw a funnel cloud to the N.W. of Winkfield at 1550 GMT. The funnel soon split up and dissipated. Mr. A. Lea, another witness, told Mr. Fishwick that the funnel appeared to touch the ground in the Foliejon Park area (SU 900740), but Mr. Fishwick was unable to find any evidence of damage (*J.*

Meteorology, 11, 284, October 1986: *Climatological Observers' Link,* August 1986, p.14).

There was a depression over southern England on the afternoon in question, with heavy showers and thunderstorms causing flooding in places. At 500mb a trough covered Britain, with a small low centre near S.E. Ireland.

Continental tornadoes in August 1986

Tornadoes were reported on 11th-12th, 17th and 18th in France, on 18th in Italy and on 26th in the Netherlands. With the exception of the Dutch event conclusive evidence of a tornado is lacking in each case, and the damage could possibly have been due to downburst winds.

Ftn1986August11/12. *Gresse-en-Vercors (Isère)*

During the night of 11th-12th a tornado caused a great deal of damage to 150 hectares of pine forest. The affected area was 4-5km long and 500m wide. The edge of the damage track appears to have been very clearly marked (*Le Dauphiné* of 15th August mentions that the tornado "passed some metres from" a building, but did not damage it). A shallow low covered much of the continent at the time, with a S.W. flow at 500mb.

Ftn1986August17. *La Charité-sur-Loire (Nièvre)*

This tornado struck a camping site during the evening. Caravans and tents were destroyed; a woman tourist was killed and 14 people were injured, three of them seriously. The damage was at about the T4 level. The windstorm was very localised, and the south part of the town was unaffected. Large hailstones were reported in the departments of Nièvre and Cher (in the latter they were said to be "as large as a fist") (*Le Dauphiné,* 18th August). The area was close to a cold front associated with a very shallow area of low pressure. There was a westerly flow at 500mb.

Ftn1986August18. *Les Abrets (Isère)*

A T3-4 tornado, accompanied by a thunderstorm with rain and hail, struck the area at 1430 local time. Power was cut off for 1½ hours or more; trees and roofs were severely damaged and shops flooded (*Dauphiné Libéré,* 19th August). Although as with the previous cases, the press report called the event "une tornado", the damage could have been caused by a severe downburst. Serious damage occurred in several other places in the region. There was a shallow low over much of Europe; at 500mb the flow was from the S.W.

Itn1986August18. *Casorezzo*

A "whirlwind" hit the village of Casorezzo at night. Dozens of people were injured by flying glass. Firemen said that 90% of the houses in the village were damaged; one house collapsed, seriously injuring a 70-year-old woman. On the outskirts of Milan hailstones "the size of apples" carpeted the roads, hampering rescue services trying to answer hundreds of distress calls from people whose homes were flooded or had the roof blown off (*Coventry Evening Telegraph, Shropshire Star,* both 19th August). Hundreds of buildings were unroofed, trees uprooted and power lines brought down. Road and rail traffic were halted. Milan and surrounding rural areas were without power for up to four hours (*Scarborough Evening News,* 19th August).

NLTN1986August26. *Meerwijck to Ekenstein*

A severe tornado of about force T6 formed as a rain shower passed over the area E. of Groningen in the N.E. of the Netherlands at about 1620 local time. The track was from Meerwijck on the Zuidlardermeer N.N.E. to Ekenstein, a distance of 15 kilometres. The track was 50-60 metres wide at first, gradually narrowing to 10-15 metres towards the end. Many trees were uprooted and caravans damaged or destroyed; one caravan was lifted over a stretch of water 40 metres wide. Fishing boats were lifted out of the water and dropped on the bank. Farm buildings, especially barns, were badly damaged (one large barn was completely wrecked, while a dwelling house a few metres away was left standing). A farmhouse and a public baths lost their roofs, and an unoccupied house was demolished. Another house had all the windows broken and the walls and roof shifted out of alignment, while water and mud from a nearby lake were dumped in the house. A Volkswagen minibus with three occupants was lifted and dropped several metres away in a dry ditch. A car moving at 90 kilometres per hour (about 55 mph) was unable to keep pace with the tornado, which slowly pulled away from the car; the speed of advance of the tornado was roughly comparable with the wind speeds at a height of two to five kilometres. The tornado occurred behind the cold front of ex-hurricane Charley. At 500mb there was a low over Britain. (From an excellent, detailed account, with photographs of the tornado and the damage it caused, by Wigbold Wierenga in *Weerspiegel, 13,* 674-687, September 1986).

Land devils in August 1986.

There were four reports of land devils and one report of a shower of straw. Most were on 9th, the only really fine, sunny day over much of England. The 17th was also a fine sunny day, with a ridge over the country.

RS1986August9. Holly Hill, Kent (TQ 669629). Miss Elizabeth Hougham.
LD1986August19/I. Borstal, Kent (TQ 725658). Miss Elizabeth Hougham.
LD1986August19/II. Burnham-on-Sea, Somerset (ST 3049). Mrs. M. Mason.
LD1986August17. Rauceby, Lincolnshire (TF 0146). *Grantham Journal,* 22nd August.
LD1986August. Binbrook, Lincolnshire (TF 1995). Mr. T. M. Cameron.

M. W. ROWE, G. T. MEADEN

TORRO THUNDERSTORM REPORT: August 1986

By KEITH O. MORTIMORE
Thunderstorm Division, Tornado and Storm Research Organisation, 77 Dicketts Road, Corsham, Wiltshire

August 1986 was another very quiet month and although the total number of thunder-days over the whole of Great Britain and Ireland was only three days below the normal, an appreciable number of days saw only very isolated outbreaks and on only a few was activity anything like widespread. England, Wales and Scotland were each around three days below the normal, and Ireland, with only three days, failed to reach the normal by almost five days. Much of southern Britain reported at least one day with thunder, and away from southern and western coasts two or three days were normal. The most thundery areas were parts of East Anglia, the east Midlands and locally over and to the south-east of London where some stations reported four or five days. In northern England, Wales and Scotland activity was so scattered that many observers heard no thunder at all and at the most only one or two days were reported.

Thunder-days in August 1986 were as follows:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Ave.
England			X	X	X	X	X			X	X							X	X			X	X		X		X	X				14	17.0
Wales										X	X											X			X		X	X				6	8.9
Scotland				X	X	X	X					X			X																	6	9.3
Ireland				X															X				X									3	7.8
Total			X	X	X	X	X			X	X	X			X			X	X			X	X		X		X	X				16	18.8
Netherlands			X	X	X					X	X	X						X		X		X	X	X				X	X	X		14	16
Belgium			X	X	X					X	X							X				X	X				X	X	X	X		12	

An area of rain and thunderstorms moved north-east from the Channel Islands across central-southern and south-east England in the late morning and afternoon of 3rd and many observers remarked on the frequency of lightning from these generally high-level storms. Rainfall was sufficiently heavy in places to cause flooding, and hail fell locally in Kent. The passage of a trough was responsible for the development of showers and thunderstorms over England, Wales and Ireland on 4th, and as the trough crossed south-eastern counties of England storms became quite active and long-lasting. From 5th to 7th thundery activity consisted of just a few isolated outbreaks in Scotland and northern England; the only incident of note related to a report from Bishop Auckland (Durham) on 6th where a house was struck and damaged by lightning. The two occupants were taken to hospital suffering from shock. The first widespread thunderstorm outbreak of the month moved north-east across central and southern England and Wales during the 10th and 11th. Some of the storms were severe with torrential rain, amounting to more than 40mm in places, and quite a lot of flooding. A thunderstorm at Ecchinswell, near Greenham Common (Berkshire), during evening of 10th was particularly devastating with considerable flood damage. Road surfaces were lifted by floodwater and some were blocked by landslides. In some cases cars were overturned and carried away by the force of water. Our Ecchinswell observer measured 45.9mm but it is quite possible that a greater quantity may have fallen locally considering the degree of damage. The storm was also accompanied by hailstones 20mm in diameter. Lightning damage was reported widely over southern England, especially in the Thames Valley, and there were two reports of persons being injured in the act of using a telephone. In one of these incidents, at Greatworth (Oxfordshire), a man received burns and was temporarily blinded, and in the other a police sergeant in London sustained a damaged ear. Thunderstorms finally cleared the coast of East Anglia by mid-morning on 11th but further heavy showers broke out over southern Britain in the afternoon and there was thunder in south Wales. The storms of 10th/11th were followed by a week of inactivity during which time only a few reports were received. On 12th and 15th thundery showers were confined to northern Scotland and the Shetland Isles where, on the

latter date, a house at Trondra (Shetland) was struck by lightning and electrical equipment worth hundreds of pounds was damaged. On 18th there was dawn thunder over the English Channel to the south-east of Dover followed in the afternoon by a storm in Northamptonshire, and on 19th two rather uncertain reports were received from Kent and Co. Down (Northern Ireland), both in the afternoon.

In association with the movement of an upper cold pool across southern Britain thunderstorms affected central and southern counties of England and Wales in afternoon and evening of 22nd. Some were accompanied by heavy rain, e.g. 48.7mm at Wolverhampton (West Midlands), and hail fell very locally. A tornado funnel-cloud was observed in the Windsor-Slough area. The occasional thunderstorm lingered into the early hours of 23rd before finally dying out, and in the afternoon there were a few thundery showers in Co. Limerick (Eire). In the evening of 25th, in the circulation of an extra-tropical depression, scattered thunderstorms, driven along by near gale-force winds, were reported in Dorset, the Black Mountains (Powys) and in Lancashire. Heavy showers developed widely on 27th with scattered thunderstorms from Cornwall through Wales to Merseyside and Lancashire, and in the late evening lightning was observed over the sea from Sussex and Kent. In the early hours of 28th there were still some thunderstorms in north Dyfed, followed in the afternoon by thundery showers on Merseyside and more widely over central-southern and south-east England. There were two interesting lightning incidents, both in Hampshire. At Bedhampton a row of shops was reported to have 'lit up like a Christmas tree' as lightning travelled around the guttering of the building, and at Denmead eleven cows worth £7,500 were killed when lightning struck a tree and travelled along a fence near to where they were standing.

Acknowledgements: The Directors would like to thank all TORRO observers who have contributed to the compiling of this monthly report. Sincere thanks are also offered to observers of the Thunderstorm Census Organisation, the Climatological Observers Link, and to the London Weather Centre for information published in the Daily Weather Summary.

WORLD WEATHER REVIEW: November 1986

United States. *Temperature:* mostly warm; +3 deg. from N. Montana to Minnesota. Cold from interior Washington to Nevada and W. Wyoming then S.E. to Texas and Mississippi, then N.E. to parts of Kentucky; -2 deg. in S.W. Montana, W. Wyoming and W. Idaho. *Rainfall:* wet only in S. (E. Arizona to S. Louisiana) and E. (Florida to S. Maine and as far inland as Ohio), Over 200% from extreme S.E. Arizona to most of S.W. Texas; S. and N.W. Florida, S.E. Georgia and round Chesapeak and Delaware Bays. Also over 200% locally in Kansas and S.E. Nebraksa. Dry elsewhere; under 50% in a very large area including almost entire N.W. quarter as far E. as Michigan; most of California, S.W. Oklahoma, E. Oklahoma to S. Illinois; extreme N.E. Maine. Rainless in most of South Dakota.

Canada and Arctic. *Temperature:* warm in Alaska, N.E. Greenland, most of Canada; +4 deg. from Ontario to Alaska; extreme N.E. Greenland; +9 deg. in S. Yukon; +10 deg. in S.W. Alaska. Cold from Canadian Arctic Islands to Newfoundland, most of Greenland and Iceland; Franz Josef Land; -4 deg. in S. Baffin Island; -6 deg. in Franz Josef Land. *Rainfall:* wet on much of Pacific coast; W. Alaska, N.W. Territories, N.W. Quebec, S. Iceland, locally in N.E. Greenland. Over 200% locally in Alaskan Panhandle, W. Alaska; more widely in Keewatin District. Dry in most of Alaska, Canadian Rockies and Prairies E. to Newfoundland; S. Baffin Island, N. Iceland, Spitzbergen, Franz Josef Land, much of Greenland. Under 50% widely in Canadian Rockies and Prairies and from Spitzbergen to Franz Josef Land; locally also in S.W. and N. Alaska, W. Greenland and near Gulf of St. Lawrence.

South and Central America. *Temperature:* mostly warm in South America from 15° to 40°S.; S. Mexico to Honduras; Bahamas; +2 deg. in parts of W. Argentina, S. Brazil and Yucatan; Bahamas. Cold in Mexico (-2 deg. in N.E.). *Rainfall:* wet in N.W. Argentina, W. Bolivia, C. Paraguay, most of S. Brazil; N. Mexico (except Pacific coast). Over 200% in parts of N.W. Argentina; S.W. Bolivia, round Sao Paulo (Brazil), most of N.E. Mexico. Dry in N. and C. Chile and adjacent strip of Argentina and Bolivia; N.E. Argentina, Uruguay, extreme S. Brazil, N.W. and extreme S. Paraguay, E. Bolivia, N.W. coastal and S. Mexico to Honduras. Under 50% in all the areas except perhaps Bolivia and N.W. Paraguay; widely in Chile, N.E. Argentina, Uruguay, S. Mexico to Honduras.

Europe. *Temperature:* warm in W. from British Isles to N. and E. Spain, France, Germany, Denmark and most of Poland; round Caucasus; +2 deg. in parts of S. England, N. France and S.W. Germany. Cold elsewhere; -3 deg. in and near N. Greece and N.W. Romania; -5 deg. from N. Norway to N. and C. Urals; -9 deg. in N. Finland and N. Urals. *Rainfall:* mainly wet; over 200% in N. England, E. Netherlands to S. Poland; W. Caucasus. Dry from N. Norway to N. Urals; Iberian Peninsual, S. coastal France, Italy, S. Austria, Hungary, Balkans. Under 50% in all these areas, widely from E. Portugal to Balkans. Provisional sunspot number 6.

Africa. *Temperature:* warm in and around South Africa; +2 deg. in N. Cape Province. Cold N. of Sahara; -1 deg. widespread. *Rainfall:* wet in S.E. Botswana and N. and C. Transvaal; coast from Algeria to Egypt; over 200% in S.E. Tunisia. Dry in most of South Africa and N. of Sahara except coasts as above; Madeira, Canary Islands. Under 50% widely in all these areas.

Asiatic U.S.S.R. *Temperature:* warm in S. and E. from Caspian Sea through L. Balkhash to Lena Basin and N.E. (except Kamchatka, -2 deg.); +2 deg. over much of this area. Cold from Urals to New Siberian Islands; -5 deg. from N. and C. Urals to Taimyr Peninsula. *Rainfall:* wet from Caspian Sea to L. Balkhash to most of Ob and Yenisey Basins; upper Lena Basin; extreme N.E. Over 200% from Caspian to upper R. Irtysh; extreme N.E. Dry elsewhere; under 50% near N. Urals; Taimyr Peninsula to Kamshatka.

Middle and Far East. *Temperature:* warm in S. and E. India, Bangladesh, most of China; Mongolia, Korea, Japan, Burma, Thailand, Malaya; +2 deg. in parts of N. China and Japan and most of Korea; +4 deg. in N.E. China and N. Korea. Cold in Turkey, much of Middle East; Pakistan, N. India, parts of interior S.E. China; -2 deg. in E. Saudi Arabia, S. Pakistan. *Rainfall:* wet in N.W. Turkey, E. Saudi Arabia, extreme N. Pakistan, C. and N.E. India, N.W. Bangladesh, N. China, E. Korea, N. Laos, much of Japan and N. Thailand. Over 200% locally in all these areas except perhaps Turkey; widely in E. Saudi Arabia, C. and N.E. India, N. China, N. Laos. Dry from S. and E. Turkey through most of Middle East to Pakistan and W. and S. India; S.E. Bangladesh, S. China, parts of N. Japan; Burma, S. Laos, most of Thailand. Under 50% locally in all these areas; widely from Lebanon to W. Saudi Arabia; Pakistan, N.W. India, S. China, Burma.

Australia. *Temperature:* warm in N.; +2 deg. in N.W. Cold in S.,; -2 deg. in W. New South Wales. *Rainfall:* wet in C. Queensland and parts of S., but mainly dry; under 50% in W. and N.W. and near E. coast.

M. W. ROWE

WEATHER SUMMARY: January 1987

January, which was a month of considerable contrast, will be best remembered for the mid-month cold spell of a severity rarely encountered in the British Isles and for the appreciable accumulation of snow that covered many eastern coastal parts of England. When the temperatures finally lifted many southern parts remained totally sunless for up to 15 consecutive days.

Mean temperatures were close to 3 deg. C below the normal over southern England with deficits diminishing further to around one degree in northern Scotland. Ilfracombe (Devon) was credited with the month's highest temperature

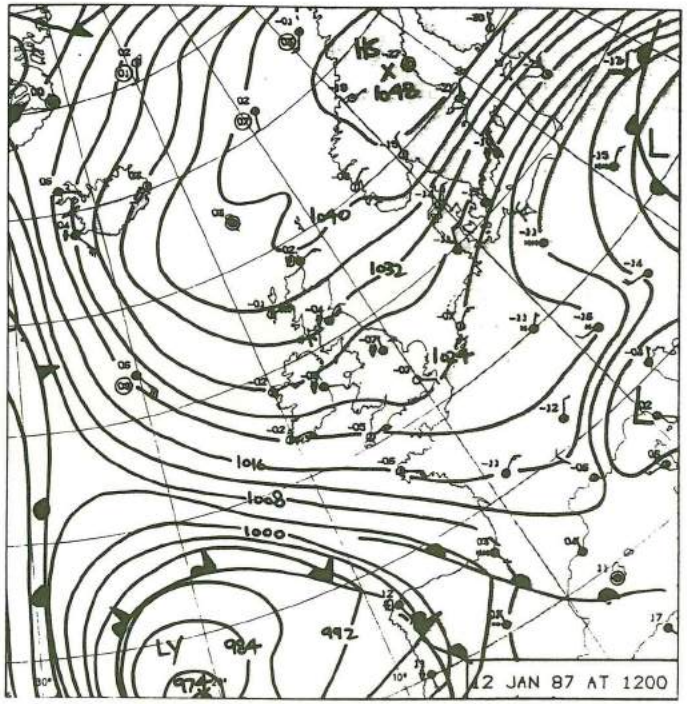

Fig.1: Weather map for noon on Monday, 12th January, 1987, one of Britain's coldest days (reproduced by permission of the London Weather Centre from the *Daily Weather Summary*). (Note the noon temperatures of -27°C and -30°C in Sweden and southern Finland).

with 12.5°C on 1st, and on 4th 12.1°C was recorded at Madley (Hereford and Worcester). On 20th 11.5°C was reached at Machrihanish (Kintyre) and at Larne and Long Kesh in Northern Ireland. With minima of 8.8°C and 8.7°C respectively on 1st Plymouth and Guernsey Airport recorded the highest night-time temperatures followed by 8.0°C at Tiree on 21st and 7.9°C at Whalsay (Shetland) and Stornoway, both on 22nd. The weather map for the 12th is given in Fig.1. The 12th was probably the most intensely cold day since January 1740 with maximum temperatures over southern Britain in the region of -6°C to -9°C over a very large area. Tonbridge (Kent) recorded -9.1°C, followed closely by -8.5°C at Okehampton (Devon), -8.1°C at High Bradfield (South Yorkshire), -8.0°C at Middleton and -6.1°C ar Inverdruie (Highland). Lowest screen minima in Scotland were -16.0°C at Achnasheen (Highland) on 12th and at Rannoch School, Dall (Tayside) and Braemar (Highland), both on 13th. Cottesmore (Leicestershire) was the coldest spot in England with -15.9°C on 13th, Witham (Essex) recorded -15.7°C on 12th and Carlton (near Nottingham) -15.0°C on 13th. On the grass Cottesmore recorded -24.6°C on 13th and Charing (Kent) -23.6°C on 12th. In Scotland Aviemore recorded a ground-level temperature of -20.3°C on 14th and in Wales, Velindre (Powys) recorded -20.2°C on 13th. Rainfall totals were well below normal virtually eveeywhere, but particularly over

England and Wales where only ten percent of the normal was recorded in parts of the south. Shetland had a very wet day on 9th when 52.2mm fell at Sunburgh but generally falls in excess of 25mm were few and far between. Heavy snow fell in places around the middle of the month with rainfall equivalents of 28.9mm at Leigh-on-Sea on 11th, 25.0mm at Falmouth on 12th, 28.5mm at Cottesmore on 13th and 34.1mm at Yeovilton on 14th. Snow depths during this period were most appreciable near to eastern coasts and also in west Cornwall. Parts of Essex and Kent were under 40 to 50cm of snow at one stage and considerable drifting blocked many roads for several days. In Cornwall, although numerous roads were blocked by huge snow drifts west of Truro and level depths were in the region of 30 to 40cm the conditions there received much less attention from the Media, if any at all. Sunshine totals were well above average over most central and western parts of the British Isles although persistent easterly winds kept it rather dull near to North Sea coasts. It is particularly interesting that even in southern areas, where sunshine was almost totally absent during the second half of the month, totals were up to 20 percent above the January average. During the severe mid-month cold spell the sea froze in a number of places adjacent to the southern North Sea, and rivers iced over in places. At Aviemore the River Spey froze completely from 13th

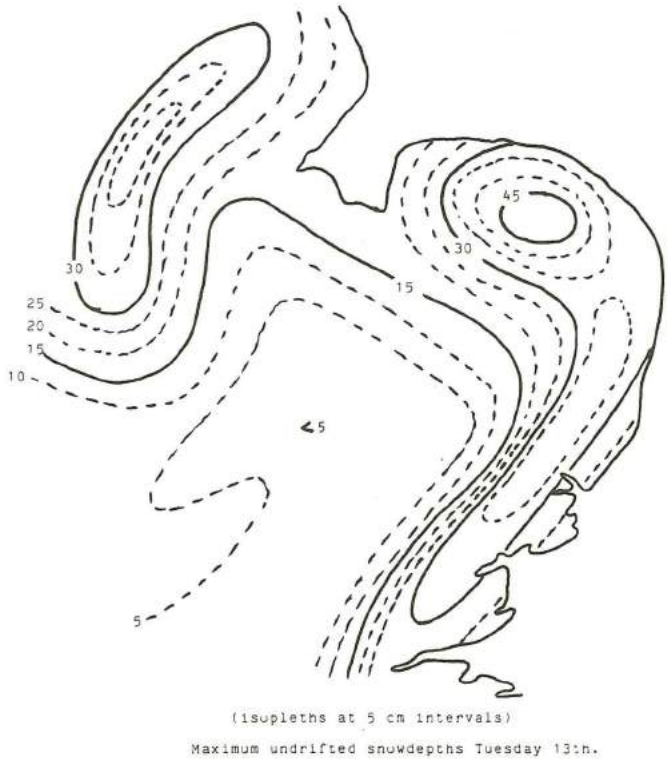

Fig.2: Snow depths in the East of England on 13th January 1987 (reproduced from *Heavy Snowfall in East Anglia*, a 21-page Anglia Television booklet prepared by Jim Bacon).

Fig.3: NOAA 9 satellite photograph at 1404 GMT on 12th January 1987 (by courtesy of Dundee University). The coasts of Holland and Belgium show up well. Central-southern England is cloud-free, but heavy snow showers are falling near eastern coasts from glaciated Cb.

to 17th and rapids on the River Druie were dammed by ice. On 19th a rapid ice-release caused rivers to overflow, depositing ice over adjacent banks.

The month began mild and wet, as a depression crossed the country, and after a couple of colder days with a few wintry showers further fronts and rain crossed all parts on 4th. Following wintry showers on 5th the weather settled down for a few days as an anticyclone moved south-east across the country only to be followed by further fronts from the Atlantic. During the 9th and 10th frontal systems attempted to cross the U.K. from the west but the development of an intense blocking anticyclone over northern Scandinavia reversed their progress and bitterly cold easterly winds spread westwards across all parts from the continent. The next few days were intensely cold almost everywhere, and with temperatures remaining well below freezing by day and night there was a penetrating severe frost. Only in the far west and north-west of Scotland did temperatures rise above freezing. Although dry in most places, snow showers developed near North Sea coasts (Figs. 2 and 3). Heavy falls were also reported in exposed parts of west Cornwall. At times snowfalls spread westwards into central and some western areas, particularly on 14th when many parts of the British Isles were affected by

longer spells of snow which was whipped into deep drifts by near gale-force easterly winds. The cold relented somewhat from 15th as the Scandinavian high pulled back into Europe, and from 17th milder weather with rain spread from the west to western and central areas, although the far east remained on the cold side. High pressure re-asserted its influence over the United Kingdom on 20th and a strong anticyclone remained slow-moving over or near to the country for much of the next week giving most parts a spell of dull and cheerless weather but with temperatures never far from normal. Brighter, colder conditions spread back from the north on 27th and the month ended on a quiet note with dry and sunny days but with quite severe frosts at night.

K. O. M.

TEMPERATURE AND RAINFALL: JANUARY 1987

	Mean				*Grass*					
	Max	*Min*	*Max*	*Min*	*Min*	*Rain*	*%*	*Wettest*	*D*	*T*
AUSTRIA: Innsbruck	-1.3	-8.3	8.4(2)	-20.6(13)	-25.3(13)	50.3		11.1(6)	–	0
BELGIUM: Uccle	-0.6	-4.6	10.6(1)	-13.5(12)		37.5	58	14.9(1)	17	0
„ Rochefort	-1.2	-7.0	12.0(1)	-20.6(13)		44.4	68	22.8(1)	12	0
„ Houwaart	-0.2	-6.8	9.9(1)	-18.0(12)	-20.3(12)	55.8	86	16.6(2)	18	0
DENMARK: Fanø	-0.7	-5.9	4.7(4)	-15.9(11)		36.3	61	17.4(5)	13	0
„ Frederikssund	-3.3	-9.8	4.1(25)	-21.8(11)	-28.5(10)	28.9	71	8.6(1)	12	0
GERMANY: Berlin	-4.1	-10.1	6.2(1)	-19.7(14)	-22.9(11)	72.8	41	14.4(1)	22	0
„ Hamburg	-2.1	-8.6	5.6(1)	-17.5(14)	-22.7(14)	57.5	56	11.5(8)	20	0
„ Frankfurt	-3.1	-6.7	11.2(2)	-17.5(13)	-19.5(13)	25.8	44	15.5(1)	10	0
„ Munchen	-2.5	-8.4	10.5(2)	-22.6(13)	-33.1(13)	61.2	52	17.3(1)	17	0
GREECE: Thess'loniki	10.0	1.8	21.6(29)	-6.8(10)		58.2		31.0(19)	11	1
ITALY: Casalecchio	5.4	-0.1	10.0(3)	-5.0(31)	-7.0(31)	49.0	111	23.0(11)	8	0
MALTA: Luqa	15.3	9.5	20.7(29)	3.4(10)	0.0(10)	38.2		11.6(31)	9	3
NETH'L'DS: Ten Post	-0.6	-5.8	6.4(1)	-15.7(14)	-16.3(30)	51.1	84	13.7(2)	17	1
„ Schettens	-0.2	-5.2	7.2(5)	-15.4(14)	-15.9(14)	42.2	63	20.8(2)	16	1
„ De Bilt	-0.1	-5.5	8.2(1)	-15.2(14)	-17.0(12)	38.0	57	10.0(2)	8	0
„ Lemmer	-0.6	-5.7	5.9(4)	-15.5(14)	-15.3(14)	41.4	64	14.9(2)	17	0
NORWAY: Donski	-8.1	-16.6	7.1(25)	-26.8(10)	-33.2(10)	21.8		10.7(5)		0
SWEDEN: Valla	-8.4	-16.7	5.0(31)	-27.9(10)	-34.0(10)	12.9		3.7(8)	13	0
SWITZ'LAND: Basel										
EIRE: Galway	6.9	1.9	11.6(19)	-8.0(13)		43.3	40	12.4(16)	10	0
„ Straide	6.2	1.0	11.1(3)	-6.5(13)	-11.3(29)	48.6	38	15.2(3)	14	0
SHETL'ND: Whalsay	4.3	1.5	9.1(22)	-4.5(13)	-9.7(13)	97.5	96	17.5(21)	21	0
„ Fair Isle	4.7	1.8	8.1(21)	-4.5(13)	-5.5(2)	77.8	73	21.9(9)	20	0
SCOTL'ND: Braemar	1.6	-4.7	8.0(21)	-16.0(3)	-19.3(3)	33.2	40	10.0(1)	14	0
„ Inverdruie	2.3	-3.5	8.9(21)	-14.2(12)	-19.6(14)	33.2	41	12.6(5)	12	0
„ Rannoch	2.7	-3.9	8.8(3)	-16.0(13)	-16.5(12)	47.1		21.2(5)	6	0
WALES: Moel-y-Crio	2.8	-1.8	9.4(4)	-9.9(12)		14.5		2.8(4)	12	0
„ Pembroke	4.8	0.6	10.2(4)	-9.2(13)	-11.6(13)	38.7	31	9.8(4)	13	0
„ Lampeter	3.6	-1.5	10.1(4)	-9.9(12)		29.5		14.5(4)	10	0
„ Velindre	2.9	-2.3	10.0(4)	-12.9(13)	-20.2(13)	35.7	38	10.9(13)	13	0
„ Carmarthen	4.1	-0.9	10.3(1)	-11.9(13)	-13.6(13)	29.3	23	7.1(14)	14	0
„ Gower	4.3	0.9	9.9(4)	-10.0(13)	-12.5(13)	23.8	19	10.4(4)	11	0
GUERNSEY: Airport	4.2	0.7	11.7(1)	-7.4(12)		34.0		9.2(1)	14	0
ENGLAND:										
Denbury, *Devon*	4.1	-0.8	11.6(4)	-11.2(13)	-15.1(13)	14.0	12	4.5(1)	11	0
Bournemouth, *Dorset*	4.0	-0.8	10.7(1)	-9.5(13)	-12.6(13)	12.4	14	4.6(14)	8	0
Gurney Slade, *Somerset*	2,4	-2.3	9.3(1)	-12.6(13)	-13.5(13)	57.0	46	19.0(4)	8	0
Yatton, *Avon*	4.0	-1.0	11.7(1)	-10.7(13)	-12.6(13)	19.2	23	4.8(4)	9	0

	Mean Max	Mean Min	Max	Min	Grass Min	Rain	%	Wettest	D	T
Bradford-o-Avon, *Wilts*	3.2	−1.5	10.3(1)	−10.9(13)		20.0	30	7.0(14)	8	0
Corsham, *Wiltshire*	3.1	−1.4	10.4(1)	−11.6(13)	−14.9(13)	15.8	22	3.9(4)	11	0
Reading, *Berkshire*	3.2	−1.3	10.4(1)	−9.8(12)	−14.0(12)	8.7	15	3.8(4)	8	0
Sandhurst, *Berkshire*	2.7	−1.4	10.5(1)	−12.3(12)	−14.4(12)	18.0	26	6.7(13)	13	0
Romsey, *Hampshire*	3.5	−1.2	11.5(1)	−10.1(13)	−12.5(31)	7.5	9	2.4(14)	7	0
Horsham, *Sussex*	2.7	−1.5	10.7(1)	−11.6(12)	−13.3(12)	21.9	30	7.3(13)	10	0
Brighton, *Sussex*	2.7	−1.4	9.6(1)	−10.2(13)		22.9		5.9(4)	12	0
Hastings, *Sussex*	2.6	−1.2	11.1(1)	−11.0(13)	−13.8(13)					0
Dover, *Kent*	2.7	−1.1	10.5(1)	−10.3(12)		32.0	44	10.4(13)	15	0
East Malling, *Kent*	2.6	−1.8	10.8(1)	−14.0(13)	−19.0(13)	63.4	103	20.2(11)		0
Epsom Downs, *Surrey*	2.3	−1.2	10.6(1)	−12.0(12)		35.1	47	9.7(12)	12	0
Reigate, *Surrey*	2.5	−1.3	10.1(1)	−11.2(12)		28.5	45	10.3(13)	12	0
Guildford, *Surrey*	2.7	−1.2	11.1(1)	−11.4(12)	−12.0(13)	24.8	34	9.9(13)	14	0
Sidcup, *London*	2.9	−1.2	10.6(1)	−10.5(12)	−12.8(13)	30.8	61	11.3(13)	10	0
Hayes, *London*	3.5	−1.2	10.7(1)	−10.0(12)	−13.1(12)	13.6	25	6.5(4)	8	0
Hampstead, *London*	2.6	−1.7	10.2(4)	−11.9(13)	−13.0(13)	15.8	25	6.8(4)	11	0
Royston, *Hertfordshire*	2.4	−1.4	10.0(4)	−12.5(12)	−17.5(12)	9.6	20	3.9(4)	11	0
Loughton. *Essex*	2.6	−1.6	9.3(1)	−10.0(12)	−13.8(12)	12.0	22	4.7(4)	10	0
Leigh-on-Sea, *Essex*	2.7	−1.0	9.9(4)	−10.4(13)	−14.4(13)	55.7	105	28.9(11)	10	0
Needham Market, *S'lk*	2.5	−1.3	9.5(4)	−12.9(13)		25.9		6.5(4)	11	0
Pulham St.Mary, *N'folk*	2.7	−2.0	9.7(4)	−11.1(13)	−14.1(13)	39.7	75	9.5(11)	16	0
Buxton, *Norfolk*	2.6	−1.5	9.6(4)	−11.2(13)	−14.1(13)	48.4	91	11.0(11)	13	0
Ely, *Cambridgeshire*	2.5	−2.7	9.4(4)	−11.5(12)		12.7		3.3(4)	14	0
Luton, *Bedfordshire*	2.6	−2.2	9.5(1)	−11.4(13)	−14.4(13)	14.6	25	5.8(4)	13	0
Oxford University	3.0	−1.5	10.3(1)	−10.5(13)	−14.8(12)	9.9	19	4.2(4)	7	0
Buckingham, *Buck'shire*	2.4	−2.0	9.3(4)	−11.6(13)	−14.8(31)	14.4	41	5.3(4)	12	0
Stourbridge, *W.Midl'ds*	2.8	−1.3	10.3(4)	−11.2(13)	−17.6(13)	23.2	33	12.3(13)	12	0
Birmingham Univ'sity	2.8	−1.5	10.5(4)	−11.2(13)	−16.7(17)	24.8	35	17.4(13)	7	0
Kettering, *North'shire*	3.3	−2.7	10.0(4)	−15.6(13)	−19.4(13)				15	0
Louth, *Lincolnshire*	3.3	−0.6	9.5(4)	−9.3(13)		44.6		13.1(12)	16	0
Nottingham, *Nott'shire*	3.4	−1.4	9.9(4)	−15.0(13)	−19.3(13)	20.5	39	7.0(13)	11	0
Middleton, *Derbyshire*	1.3	−2.1	8.2(4)	−10.9(13)		55.8		17.7(13)	14	0
Mickleover, *Derbyshire*	3.0	−1.1	10.2(4)	−10.8(13)	−13.5(13)	28.7	51	7.0(13)	11	0
Keele University, *Staffs*	2.4	−1.7	9.4(4)	−10.5(13)	−15.0(13)	23.8	36	5.4(1)	13	0
Liverpool, *Merseyside*	3.7	−1.3	10.0(4)	−9.3(12)		21.3	31	10.0(1)	9	0
Lathom, *Merseyside*	3.4	−1.0	9.4(4)	−9.8(12)		25.8		11.5(−)	7	0
Huddersfield, *W.Yorks*	2.7	−2.1	8.9(4)	−10.0(12)	−12.2(12)	39.2	43	12.5(4)	10	1
High Bradfield, *S.Yorks*	0.7	−2.1	7.9(4)	−11.4(12)						
Cottingham, *Humb'side*	4.0	−0.6	11.1(22)	−7.9(31)	−10.7(31)	35.1	62	8.4(12)	18	0
Carlton-in-Cleveland	3.2	−1.7	10.1(22)	−11.3(12)	−17.6(12)	33.9		6.7(13)	16	0
Durham University	2.9	−1.5	10.0(4)	−6.4(5)	−10.2(31)	39.1	79	12.5(1)	17	0
Sheffield, *S.Yorkshire*	3.5	−1.2	10.0(4)	−9.9(12)	−15.1(12)	67.0	83	11.9(14)	12	0
Sunderland, *Tyne/Wear*	4.4	0.0	10.7(4)	−6.0(13)		35.1	80	23.1(1)	6	1
Carlisle, *Cumbria*	2.9	−1.5	10.0(4)	−9.5(13)		47.1	67	15.4(1)	–	–
CANADA: Halifax	−0.8	−8.8	6.8(23)	−16.5(18)		147.9	103	26.1(23)	17	1
JAM'CA: Kingston	30.5	22.0	31.9(20)	19.0(8)		21.6		9.2(4)	6	0
AUSTRA'IA: Leopold	23.7	11.6	37.7(31)	6.1(9)		61.0	169	26.1(3)	7	1
„ Mt. Waverley	24.6	12.1	37.4(31)	7.5(9)		43.7		14.6(4)	11	3

CUMBRIA RAINFALL:
Broadfield, 35.0mm (47%); Appleby Castle, 33.2mm (39%); The Nook, Thirlmere, 83.8mm (31%); Coniston, 110.1mm (43%); Hawkshead, 78.8mm (40%); Kendal, Kirkbie S., 43.5mm (36%).

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FRONT COVER:
NOAA9 photograph taken at 1404 GMT, 12 January 1987: a deep cold pool (498 DM) is centred from Eastern England to Holland.

EDITORIAL OFFICE:
Journal of Meteorology, 54 Frome Road, Bradford-on-Avon, Wiltshire, BA15 1LD, U.K.